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ELECTRICAL REVIEW

and WESTERN ELECTRICIAN with which is consolidated ELECTROCRAFT

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Efficient Auxiliary Plant Service

NEW plants are more difficult to operate efficiently than auxiliary steam stations normally held in reserve on hydraulic systems. If such a plant can be shut down completely a large part of the time the operating cost may be reduced to pretty low terms by arranging the attendance for quick mobilization in case of a prolonged interruption on the transmission system or of unfavorable water conditions. Under the circumstances commonly found in practice the kilowatt-hour cost is bound to be high, figured through the year, for the station load-factor is ordinarily very poor, the fixed charges are inevitably high and the economical use of fuel is hard to maintain. The problem is still more trying, as we see it, in a plant where the steam pressure must be held not far from normal for a large part of the year and where the load conditions call for the floating of one steam-turbine unit on the bus, with the auxiliaries operating under light load and consequent poor efficiency. Even banked fires supplied with enough fuel to maintain 175 pounds steam pressure in a 500-horsepower water-tube boiler may call for 1,500 pounds of coal per boiler every 24 hours. To float a 500-kilowatt turbine on the line in such a station with the auxiliaries under steam and moving may require 1,500 to 1,800 pounds of coal per hour. The cost of this kind of insurance against waterpower and transmission difficulties is far more than the public realizes and very well might be emphasized on various suitable occasions by utility managers.

The chief engineer of a station of the above character was recently asked if it pays to install the best equipment in such plants. His positive answer was that even in a purely stand-by plant which takes very small part in the yearly energy production of a system, the best equipment means the most reliable service. A few thousand dollars more put into high grade apparatus insures a service quality which cannot be counted upon with heterogeneous second-hand or perhaps third-hand machinery picked up from scattered sources and from irresponsible sellers, so far as guarantees are concerned. In many cases the fixed charges on the better equipment need not exceed those on the less acceptable kind by more than the wages of one or two more station attendants, and many companies would not hesitate to add another man to their operating organization if by so doing the reliability of their service might be increased say 20 or 30 per cent. Again, in a growing system, a first-class modern steam auxiliary plant is a real asset, for it can be called upon to handle the new loads more and more pending the day when it will pay to lay out further large sums in the additional development of water rights, if such are held by the company.

Even though unit costs are high with auxiliary stand-by plants, the total cost of operation in dollars may be somewhat reduced by the installation of "A1" machinery. Without a careful investigation of the amount of fuel to be handled one may not attempt to specify equipment types or to insist on mechanical stoking and machinery for intensive coal handling. A careful balance may profitably be made between equipment types, their cost and the cost of maintaining the reserve plant payroll items. But in a general way, moderate outlays for labor-saving machinery are to be regarded favorably and the use of telphers and of forced or induced draft fans should be carefully looked into. While the nucleus of the operating force must be close at hand, the motor-cycle and the telephone make it entirely feasible in many cases to utilize skilled employees in other branches of public service operation and thus to take off a substantial share of the labor expense burden from the auxiliary station. But this should not be done at the expense of adequate maintenance of plant.

Making Cost Records Complete

SO much has been printed in these columns about cost data that, were it not for a recent example of omissions that has come to our attention, we would hesitate to refer to this topic again so soon. But if the central stations are going to get the best results from compilations of cost data used in security cases before commissions, they will have to add more specific engineering information to exhibits than apears in one now before us. The exhibit purports to show the detailed costs of overhead line extensions in the last half of 1916, but the items, while carefully priced and totaled, run short here and there of qualifying notes absolutely essential for checking the data presented.

Thus the number and cost and size of poles installed are set forth with care, but the kind of pole used is omitted. Nothing is said about the material of which the crossarms are composed. The make of primary cutouts, type of street lighting fixtures installed and the type and make of insulators are left to the imagination. Wire costs are well expressed, so that the exhibit is partially useful from the standpoint of an en-

gineering audit. Without enlarging upon the value of more thorough preparation of cost sheets, we may at least remark in passing that it is well for the engineers of a public utility to check over the plant addition details set forth by the accounting department before such exhibits are filed publicly in regulation cases.

It seems a pity to go to the expense of tabulating a lot of itemized costs only to render a considerable portion of the results of little significant value because the characterizations which every competent engineer recognizes as essential are omitted. Time will be saved and decisions issued earlier in security cases where companies pursue the policy of greater thoroughness. The accountant may have no interest in whether chestnut or cedar poles are used, so long as he gets his expenditure for poles accurately established under the proper classification, but the engineers and also the commission have a very direct interest in seeing to it that the descriptions of really essential items in cost exhibits are *technically specific*.

Helping Each Other

ONE problem that awaits a solution at once equitable and fair is that of formulating a co-operative policy between public utilities and the smaller electrical dealers and contractors within their territory. There is a tendency for the former with its large financial backing and engineering facilities to squeeze out the smaller business concerns, unintentionally but none the less surely. It is a condition that follows naturally the rapid and enthusiastic growth of the central-station industry, but one which should be deprecated in fairness to the small dealer and contractor.

The earnings of the central-station company depend chiefly upon the sale of energy and "service;" those of the electrical contractor and jobber upon material and apparatus required for the utilization of the former's product. These facts are fundamental, basic. The sphere of the contractor and electrical dealer is confined within somewhat closely defined limits, the sale and installation of apparatus and material. That of the central station is on the other hand wide, for not only does it supply energy but it also supplies enery-consuming appliances and makes possible the circuits for supplying them with energy. In this way the work of the utility overlaps that of the contractor to some extent.

The scale of current-consuming devices by the central-station company is but a means to an end, it being in the operation of these devices after sale as load builders and consumers of current that the central station is vitally concerned. To encourage the use of these appliances, to obtain higher load-factors and greater income from their usage, the central-station company is sometimes willing and able to forego a large portion or all of the profit from their sales since they expect to make a far larger profit during the life of the devices upon their circuits in the form of energy consumption. Moreover, the utility does not have to make the profit that does one whose livelihood or success in business depends upon their sales.

Since the earnings of the utility depend upon their load and the energy consumed, it is imperative that they should increase their connected load in every possible way. Their life depends upon it. They are glad to have the co-operation of the contractors and dealers generally, but perhaps they do not in all cases feel justified in replying solely upon their efforts. On the the other hand since the very existence of the dealer depends upon profit from sales and contracts it is but natural that he should resent the entrance of the central-station company in his field.

Every central-station company wants the good-will and friendly co-operation of the electrical contractors, and supply houses in its territory and vice versa. Each needs the other, for harmonious esprit de corps is highly desirable for the one, vitally essential for the well-being of the other. If only both interests would realize, and always bear in mind, that their interests are eventually the same, namely the healthy development of the electrical industry as a whole and the central-station industry in particular. If they would but remember that it is this that they both seek although in different ways, much good would be accomplished.

Street Lighting and War Conditions.

THE entry of the United States into the war has raised the inquiry in some quarters whether the reduction of street lighting is advisable from the military and economic standpoints. Such persons think of darkened London and of other European places where light is for the present considered undesirable on any large scale. It would seem that from the military viewpoint there is no present necessity for curtailment of this important public facility. If the military authorities deem it advisable to cut down the lighting of coastal towns within possible range of submarine guns, such action must be accepted by local communities and by the central stations with good grace.

It is worth noting, however, that it has been reported on very good authority indeed that more people have been killed by far in London from being run over by vehicles in the darkened conditions prevailing than have been the victims of Zepplin attacks, and we are inclined to think that only serious military conditions should dictate the reduction of street illumination at present. The prospects of damage on such account seem very remote indeed. As for the saving in fuel, it is a striking fact that street lighting is one of the least consumers of energy in all the range of electrical service and that the steadiness of the load is a means of economy in the long-hour operation of many a station. In most plants the load-factor is poor enough anyway during the small hours, without making it worse and actually tending to increase unit costs by withdrawing so important a public service as the illumination of streets.

HAPPENINGS IN THE INDUSTRY

Report of Tri-State Convention—Program for New-Business Meeting of Illinois State Electric Association—All Space Taken for N. E. L. A. Exhibits—Details of an Interesting Swiss Hydroelectric Plant—Boston Edison Company's New Station Extension —Tentative Program of Convention of the National Electric Light Association

MIX PATRIOTISM WITH ASSOCIATION WORK AT TRI-STATE CONVENTION.

Tri-State Water and Light Association Holds Interesting First Day's Session.

The opening session of the annual convention of the Tri-State Water and Light Association of the Carolinas and Georgia, held at Macon, Ga., April 17, was marked by an enthusiastic and interesting gathering which, while concerned with the affairs of the association, devoted considerable time to voicing its sympathy and spirit in affairs concerning the nation. Preceding the regular program of the Association, a set of resolutions, indorsing the action of President Wilson and Congress, was drawn up and approved. The hall was decorated with American flags and an orchestra rendered patriotic selections, proving an appropriate setting for the exhibition of patriotism.

The meeting was opened with an address by President D. R. Ellis, of the Macon Chamber of Commerce, and followed by Mayor Bridges Smith, both of whom extended a warm welcome to the delegates on behalf of the city. President E. M. Anderson, of Abbeville, S. C., commenced the regular program with his report, a review of the excellent work of the organization during the past year.

Rawson Collier, of the Georgia Railway & Power Company, Atlanta, chairman of the Committee on Electrical Affairs, read a comprehensive report covering the year's activities in the electrical industry. He said that recent months had witnessed tremendous increases in central-station loads, some large power companies finding it necessary to work their equipments to the utmost limit in order to supply the demand for power. He also made comments on the use of outdoor substations, including transformers, switching apparatus, meters, etc., stating that their use seemed to be growing in favor. The report included statements on the different phases of illumination, heating, power, transportation and industrial electrolytic processes, and summed up specific instances and, in a general way, the progress made in the many lines of electric development.

The afternoon session was devoted to a discussion of the establishment of laboratories for chemical and bacteriological tests at small water plants. The discussion was led by R. C. Werner, of the Georgia State Board of Health, and superintendents of plants from the three states represented indorsed the proposition of the establishment of laboratories, and explained the benefits to be accrued by the making of such bacteriological tests.

A paper by Harry Y. Carson, sanitary engineer for the Central Foundry Company of New York, was of considerable interest to the water supply men of the South because it dealt with means for improving water supply service. He stated that much of the water pumped through mains is lost by leakage and corroded pipes and emphasized the importance of using cast-iron pipe for house service connections as well as for main lines.

An exhibition of motion pictures, illustrating the utility and application of electrical apparatus and appliances to human affairs, was given by representatives of the General Electric Company.

The closing sessions of the convention were held on April 18 and 19, at which the following speakers addressed the delegates: A. M. Schoen, of the Southeastern Underwriters' Association, Dr. F. L. Parker, State Chemist of South Carolina, A. J. Sproles, of Greenwood, R. T. White, of Columbia, and others. These sessions will be reported in our next week's issue.

RESTRAINING ORDER AGAINST ELECTRICAL COMMITTEE DISMISSED.

Important Decision Handed Down by Judge Pendleton in New York City on April 13.

Judge Pendleton, of the New York Supreme Court, on April 13, dismissed the restraining order against the Electrical Committee of the National Fire Protection Association issued by Justice Delehanty, on March 28, on application of the Economy Fuse & Manufacturing Company, of Chicago.

Full particulars of the restraining order were given on page 560 of our issue of April 7. It will be remembered that this order was issued coincident with the opening of the biennial meeting of the Electrical Committee at which time revisions to the National Electrical Code were to be considered.

Argument on the order was heard March 29, the Economy Fuse & Manufacturing Company being represented by Frank H. Platt, of Platt & Field, and the defendents by Attorney Rand, of ex-District Attorney Jerome's office.

MEETING OF NEW-BUSINESS COMMITTEE OF ILLINOIS ELECTRICAL ASSOCIATION.

First Convention to Be Held at Jefferson Hotel, Peoria, Ill., April 27—Number of Important Topics to Be Discussed.

The Committee on New-Business Co-operation of the Illinois State Electrical Association, will hold its first convention at the Jefferson Hotel, Peoria, Ill., April 27. A very complete and interesting program has been arranged. John G. Learned, of the Public Service Company of Northern Illinois, is chairman of the committee, which also includes Adam Gschwindt, of Rockford; L. D. Buckwell, of Peoria, and J. Paul Clayton, of Mattoon.

Following an address by Chairman Learned, the following papers will be presented at the morning session: "Scientific Window Lighting," by Norman B. Hickox, National X-Ray Reflector Company, Chicago, Ill.; discussions by H. L. Brandli, Mt. Vernon Electric Company, and Oliver R. Hogue, Commonwealth Edison Company. "Financing Contracts for Wiring Old Residences and Additional Wiring for Appliance Sockets in Premises of Residence Customers," by F. H. Scheel, Public Service Company of Northern Illinois; discussions by W. A. Giffen, Rockford Electric Company; W. P. Lyon, Commonwealth Edison Company; Lee E. Spear, Springfield Light, Heat & Power Company, and W. P. Meiser, Illinois Traction System. "Electrification of Coal Mines," by Orlie Rue, Central Illinois Public Service Company, Mattoon, Ill.; discussions by R. S. Woltz, Springfield, and E. R. Elan, Illinois Traction System.

A luncheon will be held at noon at the Jefferson Hotel, following which there will be an address on salesmanship by A. F. Siebert, of the Dayton (O.) Insulating Die Company.

At the afternoon session the following papers will be presented: "Electrical Merchandise, Its Sale and Its Upkeep," by E. C. Forest, Rockford Electric Company; discussion by Ernest A. Edkins, Commonwealth Edison Company, Frank Lebkicker, Alton Gas & Electric Company, C. A. Morse, Central Illinois Public Service Company, George E. Dunn, Public Service Company of Northern Illinois, and E. Giaciolli, Public Service Company of Northern Illinois.

"Industrial Heating Applications," by L. H. Knapp, General Electric Company, and B. G. Tarkington, Hodenpyl, Hardy & Company; discussion by Roy Larson, Rockford Electric Company, George H. Jones, Commonwealth Edison Company, and C. W. PenDell, Public Service Company of Northern Illinois. "Electric Cooking," by J. Paul Clayton, Central Illinois Public Service Company; discussion by C. B. Yonts, Illinois Northern Utilities Company; W. F. Corl, Southern Illinois Light & Power Company, Mrs. Swanson, Rockford Electric Company, and Adam Gschwindt, Rockford Electric Company.

ANNUAL MEETING OF SOCIETY FOR ELECTRICAL DEVELOPMENT TO BE HELD MAY 8.

Directors for Ensuing Year to Be Elected and Campaigns to Be Considered.

The annual meeting of the Society for Electrical Development, Inc., will be held May 8, at its offices in the United Engineering Societies' Building, New York City.

Directors for the ensuing year will be elected.

The report of J. M. Wakeman, general manager of the Society, will be presented. The plans for 1917 and early 1918 will be discussed and voted upon.

The Society has some comprehensive sales plans to present which are expected to follow up the good work of "America's Electrical Week" and "Wire-Your-Home Time."

Following the annual meeting the board of directors will meet to elect officers for the ensuing year. The directors are expected to decide upon whether there should be another Electrical Week this year, or next spring and to appoint a committee to take active charge of such a campaign.

ALL SPACE TAKEN FOR N. E. L. A. EXHIBIT.

Arrangements Being Made to Secure Additional Space to Accommodate Late Applicants.

The Assignment Committee of the National Electric Light Association held its meeting at the offices of the Association, 29 West 39th Street, New York, N. Y., April 5, at which time assignments were made for this year's exhibit for the Atlantic City convention.

The Exhibition Committee has arranged for over double the amount of space ever used by the Association and for the first time in the history of the Association every inch of space was applied for previous to assignment; and it is two months before the convention, which is all the more remarkable from the fact of the present conditions. Additional applications are coming in almost daily and it will be necessary for the Exhibition Committee to plan additional space, if possible, to care for the Class "D" members who have not already applied for space but who wish to make an exhibit.

The location of the meeting rooms at Atlantic City is ideal, so far as the Association is concerned and also from the manufacturers' standpoint, as it is necessary for the delegates to pass through the exhibits to reach the meeting rooms.

The Lamp Committee has completed the plans for its display, and there is no question but that it will be the most complete and unique exhibit of lighting effects ever shown at one time in this country. The decorations covering exhibits will be very simple but unique in many respects, and, principally, upon lighting lines.

The Executive Committee of the National Electric Light Association is particularly anxious that each manufacturer who exhibits will have some one or more features in his exhibit of a working or educational nature, and is very anxious that this be given every consideration by the manufacturers this year.

The personnel of the Exhibition Committee is as follows: J. W. Perry, chairman, H. G. McConnaughy, secretary, Charles Blizard, S. E. Doane, F. H. Gale, J. F. Gilchrist, J. C. McQuiston, John Mustard, C. L. Pierce, Jr., and F. R. White.

CHICAGO TELEPHONE COMPANY MAKES BIGGEST GAINS IN ITS HISTORY.

New Orders at Rate of 60,000 Telephones Per Year Ascribed

During the first three months of 1916 the Chicago Telephone Company gained 13,000 telephones, while for the same period this year, the gain is 15,000, 12,200 in the city and 2,800 in the suburban division. The gain is in excess of 60,000 telephones a year, and is greater than ever before and fairly represents the feverish activity produced by the war conditions.

As a matter of fact, 28,000 telephones were put in in the three months, but 13,000 were taken out. A normal and satisfactory condition is to put in two telephones to gain one, but the showing is slightly better than this now. In 1914, when business conditions were bad, two telephones were taken out for every one put in, for several months.

There is a constantly increasing difficulty in adding new telephones because of the shortage of material of all kinds. The supply of about everything that goes into the building of a telephone exchange is about exhausted and little can be had even at almost double the old prices. There will be unusual delays in filling orders.

PENNSYLVANIA ELECTRICAL CONTRACTORS TO MEET.

Annual Convention at Philadelphia, Pa., June 19, 20 and 21.

The annual convention of the Electrical Contractors' Association of the State of Pennsylvania will be held at Philadelphia on June 19, 20 and 21, inclusive.

The headquarters will be at the Hotel Adelphia, Thirteenth and Chestnut Streets. This hotel is especially adapted to such conventions and has for years been the center of all Jovian activities.

The Association expects a very large attendance owing to the great interest which was displayed last year when the convention was held at Wilkes-Barre. Prominent persons in the electrical and business world will address the meeting, and there will be open sessions which will prove most interesting. Very elaborate entertainment of delegates and guests will be provided, and a special feature of the convention will be an electrical exhibit both for the trade and open to the public. This exhibit will be held in a very large hall in the hotel, which will be elaborately equipped and decorated for the occasion.

A number of prominent firms have already applied for space in the exhibit hall, and the entire affair promises to be one of the most successful in the history of the trade. F. M. Shepard, 1516 Sansom Street, Philadelphia, Pa., is chairman of the Publicity Committee, having arrangement in charge.

NEW YORK JOVIANS HAVE PATRIOTIC LUNCHEON.

Resolutions Adopted Approving President Wilson's War Message to Congress.

Dr. Talcott Williams, director of the Columbia School of Journalism, was the principal speaker at a big patriotic luncheon given Wednesday, April 11, by the Jovian League of New York. Nearly 200 were present.

Dr. Williams is considered one of the best versed men on the war and its relation to business. He spoke particularly of the important part the electrical industry would play, both in aggressive and defense warfare. This world's conflict will be, as he termed it, "an electric war."

Following his stirring address, J. M. Wakeman, vice-president, introduced, and the League adopted, the following resolution:

"Resolved, That the New York Jovians here assembled in behalf of the 1,400 New York Jovians, part of the National Jovian Order with a membership of 18,000 men engaged in the electrical industry, do hereby heartily approve the recent message of the President of the United States; endorse the action of Congress and pledge themselves to an undivided loyalty and whole-hearted service to the Constitution, the Flag and the President of the United States."

Arthur Williams, president of the League, presided. Patriotic songs were sung. Stewart's Restaurant was tastefully decorated for the occasion and it was generally voted the best meeting in months.

Standardization and Engineering Industry in England.

The James Forrest Lecture at the Institution of Civil Engineers, London, England, on May 2, will be delivered by Sir John Wolfe Barry, the initiator of the organized movement of standardization in England. His subject is the standardization of engineering materials and its influence on the trade and prosperity of the country. The Engineering Standards Committee (London) has appointed local committees in 12 countries abroad and when the necessary arrangements can be completed British standard specifications will be available to the public both in their English and foreign editions at a flat rate of 24 cents. In connection with this new development the appeal to the British engineering industry has so far resulted in the receipt of contributions amounting to over $600,000 from the leading technical institutions, trade making a grant of $50,000.

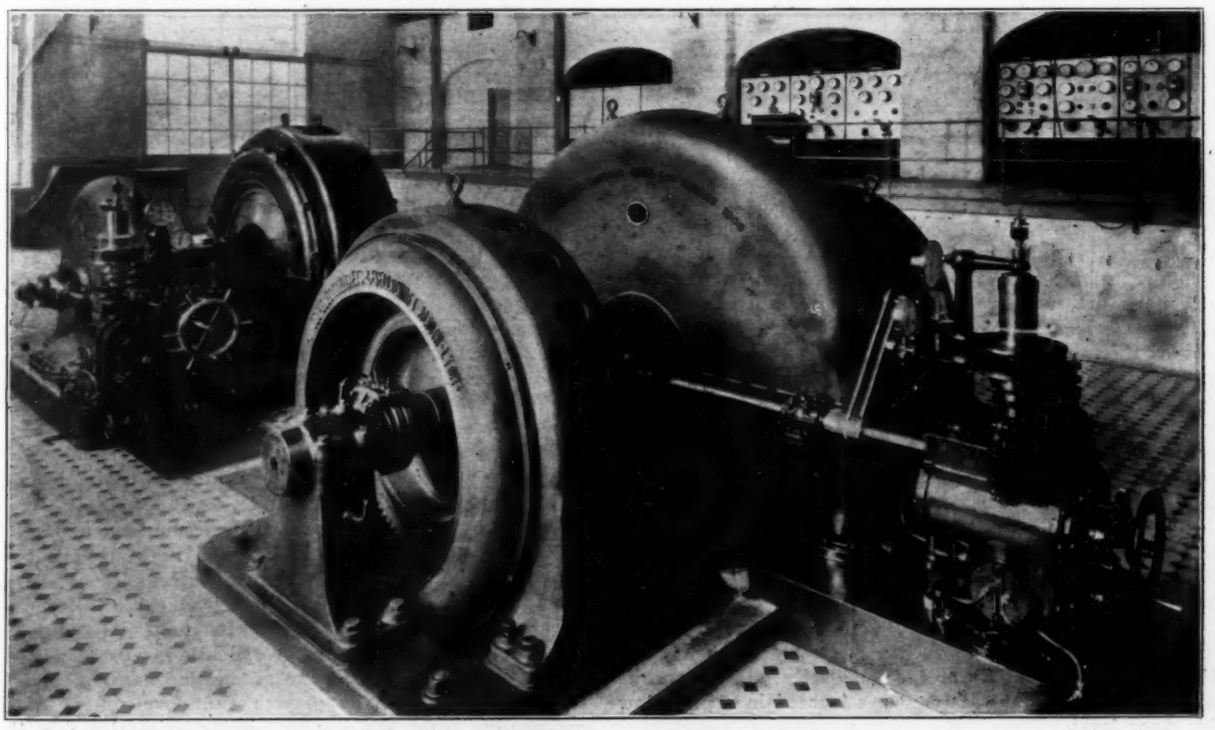
An Interesting Swiss High-Head Hydroelectric Plant.

The accompanying illustration shows the interior of the hydroelectric power plant at Arniberg, Switzerland, operating with a head of nearly 3,000 feet. At this installation the water is obtained from two glacier-fed streams and from springs. The water after beng collected in an artificial lake situated 4,500 feet above sea level is led through two parallel pipe lines each 6,850 feet long and varying in internal diameter from about two feet to about 18 inches. At the power-house end the two pipe lines are connected by a cast-steel double bend securely anchored to a heavy concrete block, and the end thrust on the bend amounts to about a half million pounds.

This hydroelectric power station at Arniberg, near Amsteg on the St. Gothard Railway, is about 10 miles above the upper end of the Lake of Lucerne. The fall used at this station is nearly 3,000 feet in height. Besides supplying the electrical energy to the immediate district, which district is thinly populated and of a non-industrial character, the station serves as a feeder to that at Rathlausen, on the outskirts of Lucerne, more than 30 miles distant. To the former the Arniberg station supplies three-phase energy at 48 cycles and to the latter three-phase energy at 42 cycles per second.

The station is arranged for four turbine units, three of 3,000 horsepower each and one of 1,300 horsepower, but at present the installation consists of the latter unit and one of the former.

As shown in the illustration, the small turbine is coupled to a generator at each end of the shaft and the large unit is direct-connected to a single generator. The large generator has an output of 2,080 kilovolt-amperes.



Interior of Swiss High-Head Hydroelectric Plant.

BOSTON EDISON'S NEW STATION EXTENSION.

Two 45,000-Kilowatt and One 30,000-Kilowatt Units with Necessary Boilers Now Being Installed.

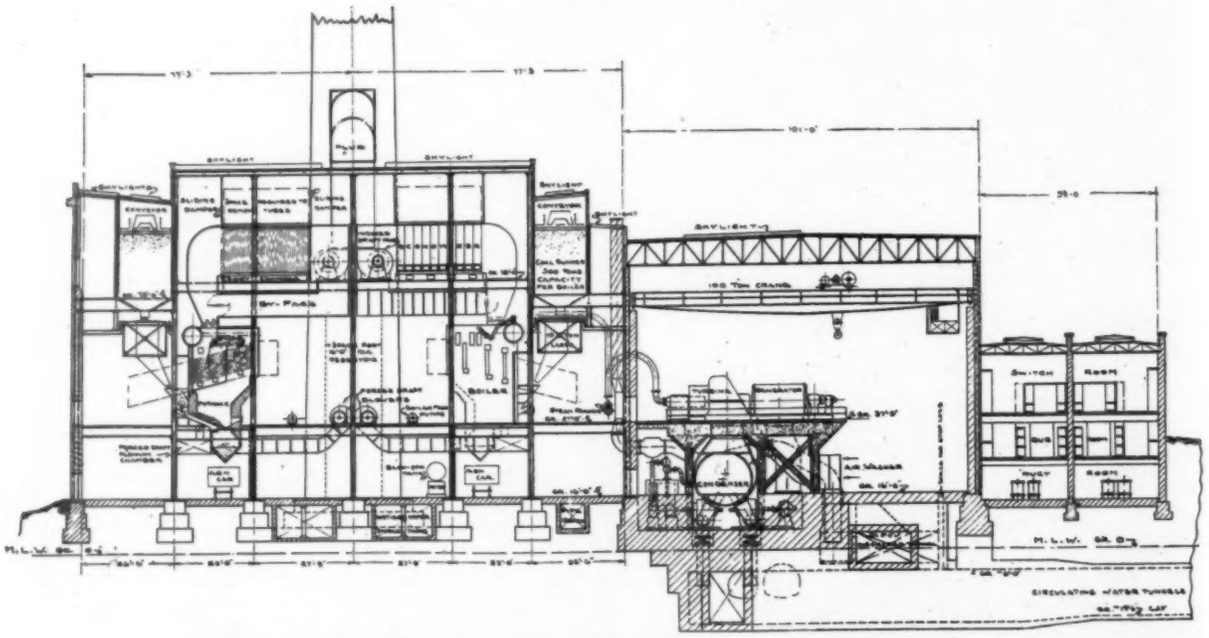
From an initial turbine installation of two 5,000-kilowatt units in 1904, the Boston Edison Company's L-Street generating station has been increased in capacity until at the present time there are 96,000 kilowatts of turbine capacity, in eight units. The boiler house has 48 512-horsepower boilers, supplying the eight turbines.

When the station was designed it was intended to have 12 5,000-kilowatt turbines and 96 512-horsepower boilers. An extension to the building making the aggregate length of turbine house 650 feet, was a part of the original plan. Now, there has been built two-thirds of this room and one-half of the projected boiler room.

The latest extension is to provide for an ultimate installation of one 30,000 and two 45,000-kilowatt turbines and 16 1,232-horsepower boilers, making a total generating capacity of 216,000 kilowatts in a space designed to accommodate 60,000 kilowatts in verticals.

In the new boiler room the boilers will be placed in two rows, back to back, parallel with the turbine room. At about the roof level of the old boiler house will be the economizer floor, and above this the coal pockets will be directly over the firing aisles.

The coal storage area is being greatly enlarged, to about double present capacity. New tunnels for circulating water for the new turbines—some 2,000,000 cubic feet per hour—will be built. The switch house will be located either just outside the turbine room on the east side of the building, or else between the boiler house and L Street. It is expected that a 30,000-kilowatt unit will be installed by early fall.



Cross-Section of New Station of Boston Edison Company.

The reasons for this economy of space are that while the first turbine ran at only 514 revolutions per minute, a new 30,000-kilowatt unit soon to be installed will operate at 1,800 revolutions; the 1904 unit required about 20.5 pounds of steam at 175 pounds boiler pressure and two-inch back pressure in the condenser to produce a kilowatt-hour. The new turbines of today use only 50 per cent of this amount of steam per kilowatt-hour, the back pressure being one inch. The new boilers are designed for 350 pounds working steam pressure. They are the B. & W. four cross-drum or marine type. This is a more compact type of boiler than the longitudinal drum type comprising the earlier installations, and output is increased by the use of individual economizers. The boiler has about kept pace with the turbine in output per square foot of space occupied, the modern improved stokers giving boilers a higher rating for peak work than was formerly possible.

The turbines to be installed will be placed crosswise of the turbine room and mounted on steel foundations. The condenser and part of the auxiliaries will be on the same floor, part of the latter being located in a pit below this floor level.

Generating Costs at Different Hours Shown.

The hour-by-hour generating costs in a steam station of moderate size have been kept, and their tabulation has shown some interesting facts bearing on the various kilowatt-hour costs at different times of day. This practice was inaugurated as an experiment last fall by Eugene Carpenter, head of several lighting utilities in Massachusetts. His aim was to learn whether surplus or off-peak power could be supplied latent customers at especially low rates, and if so, what price would yield a fair return.

Bowen Tufts reported that one of the Parker companies, with which he is connected had made such a time study, with the result that the company was selling power at certain times of day at appropriately low rates. Mr. Tufts pointed out the great value to be derived from detailed kilowatt-hour costs, especially when going after new power business. Such figures, too, are an index to certain possible economies, which may result in profit from power business in large blocks, even though taken on at low rates.

Respecting the general subject of accounting, F. L. Hall, auditor of the Naragansett Electric Lighting Company, Providence, R. I., said that the earlier practice of stinting the accounting department, as being a function of central-station work that was at best perfunctory, is passing, and a new era of closely detailed investigation of costs is here.

One of the functions of an accounting department is to keep close tabs on the growth and development of the community, noting its growth, section by section.

Tentative Program of the 1917 Convention

National Electric Light Association

Atlantic City, N. J., May 29—June 1

Monday (May 28)—Registration for all members.

Monday Evening—President's reception for all members.

General and Executive Sessions.

Tuesday Morning—Address by Mayor of Atlantic City; address by President Wagner; reports of Membership Committee, National Secretary, Treasurer, Insurance Expert, Committee on Progress, Question Box, Committee on Educational Institutions.

Wednesday Morning—Reports of Committees on Valuation and Terminology, Rate Research, Geographic Sections, Constitution and By-Laws, Relations with Other Associations, Company Sections, Finance; election of Nominating Committee; report of Public Policy Committee.

Friday Morning—Report on Doherty and Billings Prizes; action on Constitutional Amendments; report of Committee on Memorials; report of Committee on Resolutions; report of Nomination Committee; election and installation of officers; adjournment.

Commercial Sessions.

Tuesday Morning—Address by President Wagner; Chairman's address; report of Finance, Publication and Handbook Committees; election of Nominating Committee.

Tuesday Afternoon—Power Sales Bureau—Report of General Power Division on Municipal Pumping; report on Central-Station Service in Cold Storage Warehouses; report on Central-Station Service in Steel Mills.

Tuesday Afternoon—Lighting Sales Bureau—Report of the Chairman; report of Committee on Commercial Aspects of Lamp Equipment; report of Committee on Commercial Aspects of Street and Highway Lighting; report of Committee on Store Lighting.

Wednesday Morning—Power Sales Bureau—Report of Chairman; reports of Electro-Chemical Division, Industrial Electric Heating Division, Division on Steel Furnaces, Isolated Plant Division.

Wednesday Afternoon—Report of Electric Range Committee Chairman; reports of Sub-Committees on Technical Information, Water Heating, Co-operation.

Wednesday Afternoon—Lighting Sales Bureau—Reports of Committees on Industrial Lighting, Residence Lighting, Outdoor Lighting, Electric Advertising.

Thursday Morning—Reports of Sub-Committees of Electric Range Committee on Central-Station and Manufacturers' Viewpoints of Electric Range Situation; Sales Information and Commercial Recommendations Standardization.

Thursday Morning—Report of Committee on Education of Salesmen; address by O. D. Young; report of Committee on Commercial Service and Relations with Customers; report of Lamp Committee.

Thursday Afternoon—Report of Industrial Heating Bureau; paper, "Electricity in Non-Ferrous Metallurgy," by C. F. Hirshfeld; report of Merchandising Committee; report of Committee on Compensation of Salesmen.

Friday Morning—Report of Wiring Committee; paper, "Alternating Time Service," by H. E. Warren; report of Committee on Co-ordinate Advertising and Sales Campaign; election and installation of officers; executive session.

Accounting Section Sessions.

Tuesday Afternoon—Chairman's address; reports of Committees on Classification of Accounts, Relations with Other Associations, Form of Annual Report to Commissions, Accounting Rulings.

Wednesday Morning—Address by W. B. Brockway; reports of Committees on Cost Accounting and Statistics, Vehicle Cost Accounting, Inventory Methods, Purchasing and Storeroom Accounting.

Wednesday Afternoon—Report of Accounting Educational Committee; reports of Committees on Accounting Service to Small Companies, Records, Merchandise Accounting Efficiency; election and installation of officers; executive session.

Technical and Hydroelectric Section Sessions.

Tuesday Afternoon—Chairman's address; Safety Rules and Accident Prevention; Overhead Line and Inductive Interference; first business meeting; paper, "Introduction of Metric System," by Dr. Kennelly.

Wednesday Afternoon—Report on Prime Movers; report on Power Supply for Electrification of Steam Railroads; progress report.

Thursday Morning—Report on Electrical Apparatus; paper on Operating Problems Occasioned by Large Industrial Apparatus; paper on Working on Live High-Voltage Lines.

Thursday Afternoon—Report on Meters; report on Underground Construction and Electrolysis; second business session.

Electric Vehicle Section Sessions.

Wednesday Morning—Chairman's address; Treasurer's report; Secretary's report; Federal and Municipal Transportation Committee report; Garage and Rates Committee report; Insurance Committee report; Legislation Committee report; Manufacturers' and Central-Station Co-operation Committee report.

Wednesday Evening—Address by an official of Pennsylvania Railroad; address by an official of American Express Company; papers on "Electric Industrial Truck," "Central-Station Use of Electric Vehicles," "Electric Vehicle from the Customers' Standpoint."

Thursday Morning—Reports of Motion Picture Film Committee, Standardization Committee, Operating Records Committee; general discussion on electric vehicle progress.

Speed Control of Polyphase Motors

A General Discussion of Methods of Speed Adjustment of Polyphase Induction Motors—Speed Control Through Change in Number of Poles, Cascade Connection, and Secondary Resistance

By GORDON FOX.

This is the first of two articles on this important subject in which Mr. Fox describes the various methods used for speed control of polyphase motors, their characteristics and relative advantages. The present article deals with control by means of multispeed motors and cascade-connected sets through which the synchronous speed is changed; it also takes up control through rheostatic change of secondary resistance. The second article, to appear in the next issue, will continue the treatment of speed control through variation of slip as applied in the primary-control and dynamic-control systems.

THE RATE of rotation of an induction motor is determined by its synchronous speed and the amount of rotor slip. In order to cause a change in speed, at least one of these factors must be varied. There are several methods of speed control applied to the polyphase induction motor. Two classes of machines operate primarily through change of synchronous speed. These are:

Multispeed motors.

Cascade-connected sets.

Three common control methods depend upon variation of the amount of slip. These are:

Rheostatic control.

Primary control.

Dynamic control.

Combinations of these methods are also used. The various systems have widely differing characteristics. Each finds application for particular classes of work. None of the methods is suited for universal usage.

Changing the Number of Poles of Multispeed Motors.

The synchronous speed of an induction motor depends upon the frequency of the circuit and the number of poles per phase in the stator winding. Practically all induction motors operate upon fixed-frequency circuits. To change their synchronous speed it is necessary to change the number of poles. This can be accomplished by using two or more separate primary windings, each having a different number of poles, or by using a single winding which can be connected so as to form different numbers of poles. Theoretically, quite a number of speeds are possible. Practically, four synchronous speeds are the maximum number feasible for squirrel-cage motors, and two for wound-rotor motors. The squirrel-cage rotor is adapted to any number of poles, whereas the secondary windings of the wound-rotor motor must be reconnected for different speeds.

Two synchronous speeds, bearing the ratio of 2 to 1, may be secured by simple reconnection of one set of stator windings. This is accomplished by rearranging the circuits so that all coils of each phase have like polarity. An equivalent number of consequent poles of opposite polarity then occur at intermediate points. This doubles the number of effective poles and halves the synchronous speed. Figs. 1 and 2 show how the coils of a four-pole motor may be reconnected to give eight poles. It will be noted that in reconnecting the coils have been changed from parallel to series. This is because it is necessary to have twice as many coils in series for the low speed, since twice the turns are required to produce the proper counter electromotive force. The changes in the connections are made by bringing out the coil ends and completing the connections for either arrangement in the controller.

Speed ratios other than 2 to 1 must be obtained through the use of separate stator windings. Thus a 60-cycle motor having a six-pole winding and a four-pole winding will operate at either 1,200 or 1,800 revolutions per minute.

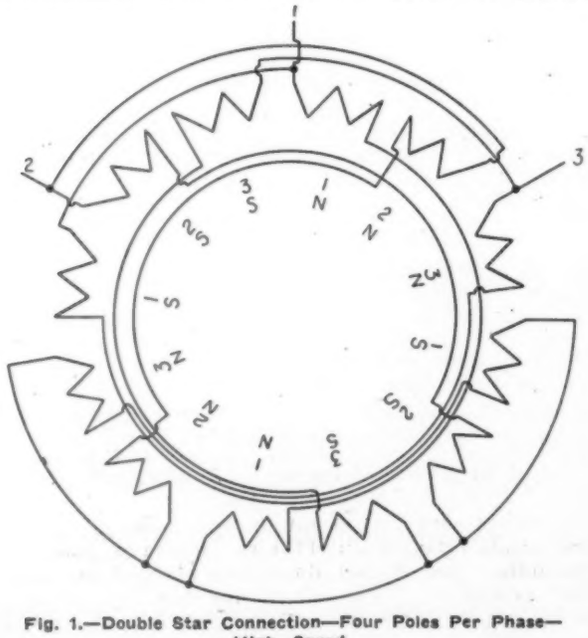


Fig. 1.—Double Star Connection—Four Poles Per Phase—High Speed.

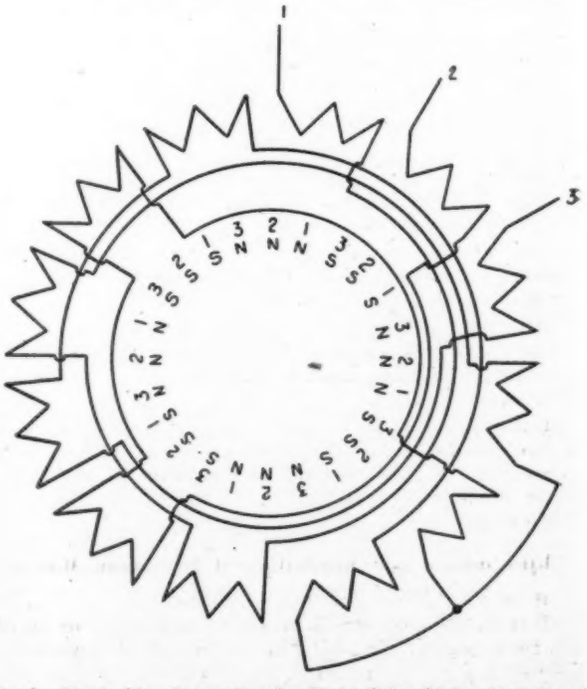


Fig. 2.—Single Star Connection for Eight Poles Giving Half Speed.

If these two windings are arranged for reconnection for consequent poles, two additional speeds, 600 and 900 revolutions per minute, respectively, are possible. Where separate windings are employed, one set is placed in the

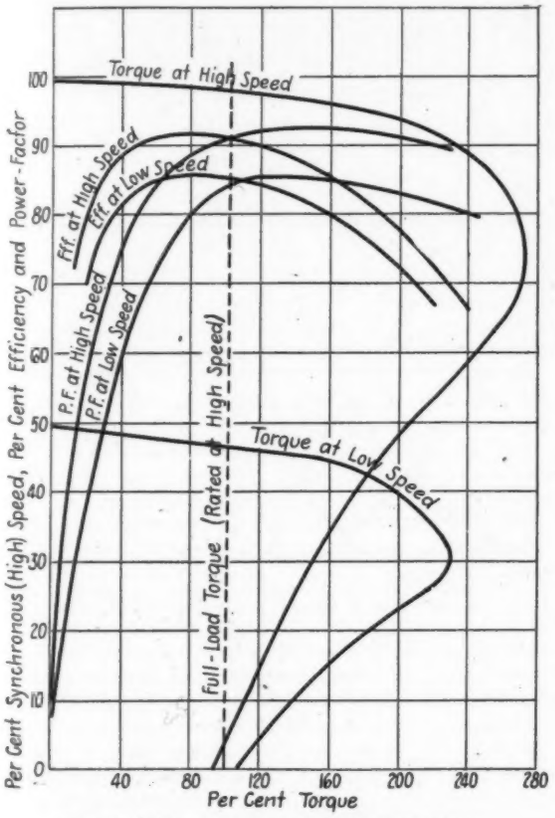


Fig. 3.—Characteristics of Multispeed Motor.

bottom of deep stator slots, the second winding being inserted above them, there being thus two layers. Access to the lower coils for repairs can be gained only by removal of portions of the top layer.

The controller of a squirrel-cage motor having a 2 to 1 ratio is not complicated. But six leads are brought out from a three-phase motor of this type. Arranging for two speeds from two separate windings also requires six leads between motor and controller. Four speeds from two windings requires 12 leads between motor and controller. Wound-rotor motors demand twice the number of leads, since their rotor windings must also be reconnected. This introduces complexity, requires more slip-rings and brushes and makes the controller very expensive. Wound-rotor motors are therefore not regularly built for more than two synchronous speeds.

Multispeed motors are ordinarily built for three-phase circuits only. For use on two-phase circuits, Scott-connected transformers are used to change to three phase. Controllers for two-phase motors are more complicated and more expensive. It should be noted that changes from one speed to another are obtainable only by opening the primary circuit and then closing it with different connections. This necessary interruption of the power supply is an undesirable feature of the multispeed motor in many uses.

Characteristics and Application of Multispeed Motors.

The multispeed motor is not in reality an adjustable-speed machine, since but a very limited number of speeds can be obtained. In the great majority of applications but two speeds are possible. At each setting the motor operates essentially as a simple induction motor, having squirrel-cage constant-speed or wound-rotor varying-speed characteristics, according to type. Since most multispeed motors are of the squirrel-cage design they offer two, three or four widely differing but approximately constant speeds. The capacity of a multispeed motor varies with its rotation. The torque remains approximately the same for each connection and the horsepower capacity is greater at the faster speeds. A multispeed motor is essentially a constant-torque machine.

The efficiency of multispeed motors is quite high, being but slightly inferior to that of the simple inductor motor. The efficiency is usually a little better at the faster speed. The power-factor of the multispeed motor is likely to be rather low, particularly at the lower speeds. The deep slots required to carry the two-layer windings contribute to this fault. The starting torque per ampere varies approximately inversely as the speed, depending upon the connection used at starting. Squirrel-cage multispeed motors require a compensator for starting. Change from one speed to another can usually be accomplished by movement of the drum controller which reconnects the windings. This change is accompanied by a sudden rush of current similar to that at starting. Fig. 3 shows the characteristics of a 2 to 1 squirrel-cage multispeed motor.

Multispeed motors find a limited field of application. In small sizes they are applied to some printing presses having constant-torque characteristics. They are used for machine driving to a small extent, cone pulleys sometimes being used to secure intermediate speeds. Where a 2 to 1 fixed-speed, constant-torque drive is required, they are efficient, well adapted and inexpensive. Multispeed motors, with wound rotors are used to some extent for driving continuous rolls in steel mills. Here a wound-rotor characteristic is desirable because of the use of a flywheel. Two synchronous speeds, with intermediate adjustment by secondary resistance, afford a sufficient range for the work in hand and the expense of the complicated controller is not prohibitive.

Cascade-Connected Motor Sets.

By means of cascade connection, two induction motors that are rigidly connected, usually upon the same shaft, may afford a number of synchronous speeds. A combination of two such motors is called a cascade set. One of

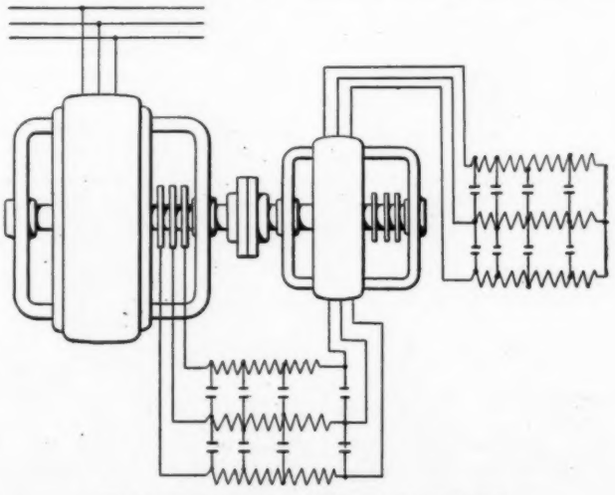


Fig. 4.—Connections of Typical Cascade Set.

the motors must have a wound rotor. The two motors are usually arranged for different numbers of poles. By operating either motor alone, two synchronous speeds are obtainable. If the motors are built for multispeed connections of the stator windings four synchronous speeds are possible through use of the motors individually.

If the secondary of the wound-rotor motor be connected to the primary of the second motor, as in Fig. 4, the second motor is subjected to a voltage at variable frequency. The set will operate at a point dependent upon the combined number of poles of the two motors. This may be seen most readily by considering a cascade set composed of two motors having the same number of poles. When the first motor is at rest, its rotor winding has generated within it a voltage at line frequency and this is applied to the stator of the second motor. Both motors then tend to accelerate. As the speed increases the frequency of the current in the circuit composed of the rotor of the first motor and the stator of the second motor, is decreased. At half speed the frequency of the current in this circuit is half line frequency. At this frequency the second motor will run at half speed. If the rotor of the first motor should increase its speed further, the frequency applied to the stator of the second motor would decrease and the second motor would tend to slow down. It is thus evident that the normal speed of the set is half that of either motor operating alone.

In general, the speed of a cascade set equals

$$\text{Cycles} \times 120/(P+P_1)$$

where P and P_1 are the number of poles of the first and second motors, respectively. The plus sign is used in the case of direct cascade connection and the minus sign in the case of differential cascade connection. Motors are connected in direct cascade if they both tend to start in the same direction, and in differential cascade if they tend to start in opposite directions. It should be evident that direct cascade reduces the speed of a set below that of the synchronous speed of the first motor, while differential cascade increases the operating speed above the synchronous speed of the first motor. If a set is arranged for both direct and differential cascade connection the speed range may be materially increased. The change from one type to the other is accomplished by reversal of one phase in the secondary circuit of the first motor.

The differential cascade connection is limited in its application. A differential cascade set exerts comparatively low starting torque, since the motors are opposing each other. It is necessary to bring the set up to speed by use of the second motor alone. Differential operation may then be secured by reduction from the higher speed, using the cascade connection. It is necessary that the second motor have less poles than the first motor in order that this higher speed may be possible. A differential cascade set will not accelerate from a low speed.

It will be seen that cascade motor sets are similar to multispeed motors in that they afford a number of fixed synchronous speeds available from direct cascade sets to- of the wound-rotor type, it is possible to utilize rheostatic control to obtain intermediate speeds. The number of syncronous speeds available from direct cascade sets together with the number of terminals to be brought out to controllers is given in the following table:

First Motor.	Second Motor.	Number of Synchronous Speeds.	Number of Leads.
Wound rotor	Squirrel cage	4	9
Wound rotor	Wound rotor	4	12
Wound rotor	Squirrel-cage multispeed	7	12
Wound rotor multispeed	Wound-rotor multispeed	12	18

Characteristics of Cascade Motor Sets.

The capacity of a cascade set depends upon the relative sizes of the units and the method of operation and much depends upon the behavior of the load at different speeds. The torque of each motor of the set is approximately equal to the total torque times the ratio the number of poles of that motor to the number of poles of the two motors combined. Thus, in a set having one unit with four poles and one unit with eight poles, the four-pole motor will exert one-third of the combined torque. Since the power of the four-pole motor must pass through the eight-pole motor, it does not increase the maximum torque of the latter. As the set operates in cascade at reduced speed the capacity is proportionately reduced. The breakdown output of the set will be a little less than two-thirds of that of the large motor running alone.

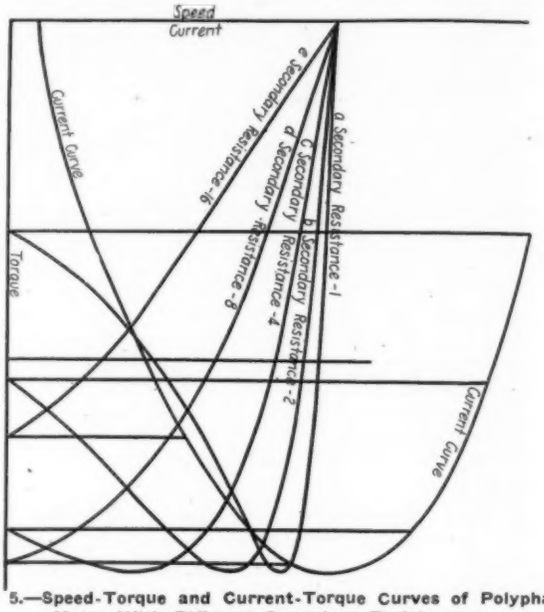


Fig. 5.—Speed-Torque and Current-Torque Curves of Polyphase Motor With Different Secondary Resistances.

The lowering of the breakdown capacity through cascade operation forces the use of comparatively large units. With two units having equal numbers of poles the breakdown capacity of the set is less than half that of a single set. If one machine has 16 poles and the other four poles the breakdown capacity is nearly four-fifths of that of the larger 16-pole motor. Loss of overload capacity is thus less severe where moderate speed changes are secured by addition of a small motor having few poles in cascade with a larger motor with a comparatively large number of poles. With differential cascade connection the torque of the second motor opposes that of the first motor and thus reduces the torque of the set with increase of speed. The proper application of a cascade set thus requires accurate knowledge of load conditions.

A number of speed changes may be accomplished with cascade sets without opening the primary circuit. This is done by introducing resistance and cutting it out in steps. Fig. 4 shows the location of the resistances used for this purpose. This ability to change speed without primary switching is a valuable feature for some classes of work.

The efficiencies of the individual units of a cascade set are the same as those of ordinary induction motors of the same type. The efficiency of the combined set is somewhat less than that of a multispeed motor of similar capacity. The efficiency is necessarily low since the input of the second unit must pass through the first unit. The power-factor of a cascade set is rather poor. The magnetizing current for the set is that of the combined units and the magnetic leakages are also additive. Large magnetic leakage causes not only poor power-factor, but also low maximum torque.

Cascade sets are not commonly employed in small sizes, but large units are quite often used where special speed ratios other than 2 to 1 are desired. They are also used where speed changes must be frequently made or where

high primary voltage would prohibit the switching operations incident to the use of the multispeed motor. It is desirable that the horsepower required at high speed be greater than that at low speed since the capacity of the set is decreased at low speeds. Cascade sets are comparatively less expensive, more economical and more efficient where only moderate changes are obtained through the use of a comparatively small second motor.

Rheostatic Control of Motor Speed.

It has been already pointed out that the actual speed of an induction motor is somewhat below synchronous speed. The amount of difference between synchronous speed and actual speed depends upon the slip. The slip depends upon the load and the resistance of the rotor circuit. Evidently, with a given load, it is possible to secure a moderate change in speed through variation of the slip by changing the resistance of the secondary circuit. This method is applicable by means of wound-rotor motors supplied with controllers and external secondary-resistance girds.

This is a rather commonly used method, but is limited in desirable features. But a moderate range of speeds is possible. Synchronous speed is the maximum rate obtainable and about half synchronous speed is the lowest value feasible in the majority of cases. The speed cannot be termed adjustable, since it is adjustable only at constant torque. Any change of load causes a change in speed, since, as before stated, the slip depends upon both load and secondary resistance. It is evident that a varying load will give a varying speed. Removal of load causes increase of speed. With very light loads the slip is greatly reduced and the speed reaches nearly synchronous value. At light loads it is impossible to secure more than a five to ten per cent range of speed control without the use of extremely large resistances. A given setting of the controller will provide a ten per cent slip at light load and a 50 per cent slip at full load. The speed at any

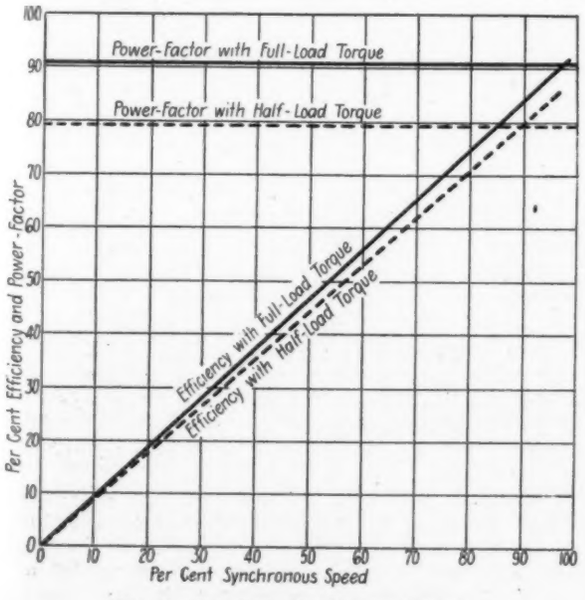


Fig. 6.—Per Cent Synchronous Speed.

controller position is thus indeterminate and depends entirely upon the load.

The method is therefore ill adapted to changeable loads, except in connection with continous manual control. Since the load speed of a motor varies widely with load changes it is necessary that the exact amount of load be known, if a definite load speed is to be obtained. Overmotoring is not permissible, if a definite speed reduction is desired, since the range of obtainable speeds is less, the smaller the load. The characteristics of rheostatic control are well illustrated by the curves in Fig. 5 showing the operation of the wound-rotor motor with different secondary resistances.

Since the primary magnetism of the motor remains practically constant, a given torque requires a given secondary current, regardless of the speed or rotor resistance. A motor of this type is a constant-torque proposition and its horsepower ouput is reduced at decreased speeds. At full speed, full load, most of the input is converted to mechanical output. At half speed the same input develops but half the mechanical ouput. The balance of the power is wasted in the secondary-resistance grids. The speed reduction is obtained through heavy sacrifice in efficiency. In general, the efficiency is reduced almost in direct proportion to the reduction in speed. The low efficiency makes this method of speed control ill suited for motors of moderate or large size operating rather continuously at reduced speeds under load. The wastage of power in such cases may, in fact, be enormous.

Where it is desired to find the efficiency of a wound-rotor motor at any given speed, the following method may be applied. On a speed-efficiency curve, plot known value of efficiency at full-load torque and full-load speed. Connect this point with the zero of co-ordinates. The efficiency with full-load torque at any reduced speeds may then be read directly from this curve. If the half-load maximum-speed efficiency is known, a similar line may be drawn to represent the efficiency with this torque at different speeds. Fig. 6 illustrates the method as applied to a specific case.

The power-factor of the wound-rotor motor with rheostatic control is dependent upon the torque, irrespective of the speed and is rather high, being better at full load than at fractional loads.

The same secondary resistance is used both for starting and for speed control and no compensator is required. Resistances for speed-control service may be different from those designed for starting duty, inasmuch as they must have greater heat-dissipating qualities because of the more continuous service. In other respects the wound-rotor motor as used for speed control is identical with that used for frequent starting and other services.

Rheostatic control is satisfactory for work requiring a low speed for setting up and a higher speed for operating. The low efficiency at reduced speed is here unimportant. It is dapted for use where a very limited speed range is desired and where the load is not of a fluctuating character. It is also applicable for intermittent service with continuous manual control. There are many uses for this method of speed control, but there are likewise many kinds of service where it is not satisfactory. A few typical cases may be mentioned. Rheostatic control is not suited for machine-tool drives since the speed range is too limited and the rotation speed altogether too unsteady. It is not suited to any work requiring fairly constant speed with varying loads. It is not well suited for work requiring full horsepower at reduced speeds. It is undesirable for continuous service at greatly reduced speeds, because of its low efficiency.

Mt. Vernon (Ill.) Property Sold to Frey Interests.—The Citizens Gas, Electric & Heating Company, at Mt. Vernon, Ill., operated by Henry L. Doherty & Company, has been sold to the Southern Illinois Light & Power Company, which is controlled by the Frey syndicate of St. Louis. This property is disposed of because of its isolation from other Doherty operations, being the only one in Illinois, whereas the purchases control several plants in the vicinity. General Manager H. E. Brandli of the Mt. Vernon property will remain with the Doherty organization.

Electrical Equipment of the Reo Plant

An Article Dealing With the Extensive Electrical Installation in a Large Automobile Manufacturing Plant in Michigan and Its Rehabilitation to Modern Standards Without Interrupting Work

A PLANT turning out 150 complete motor cars a day, as well as a good number of motor trucks; a plant covering approximately 40 acres of ground; a plant in which 5,000 men are employed. Such is the Reo factory. The second company in the country to enter upon the construction of motor cars on a commercial scale, the Reo Motor Car Company, of Alma, Mich., has been doing business on the same site nearly 14 years. Some of the original buildings are still in use, with the original equipment in them. From them to the latest buildings, several being now under construction, a constant development is represented. Constant changes in the equipment and production methods have been necessary to keep the plant abreast of the requirements of this spectacular industry, and to work up to this remarkable output of 150 cars a day, which is by no means the ultimate.

To give a detailed, well-ordered description of the electrical equipment of this great collection of machine shops, blacksmith shops, assembly rooms, testing departments, etc., would be impossible within the space limits of this article. The plant is a labyrinth, and electricity is at work in every bay and in every corner of the establishment. What description follows touches some of the high spots, and it is hoped will not be without value to those interested in industrial applications of electricity. And what is written will be confined more particularly to methods employed in distribution of the current throughout the plant.

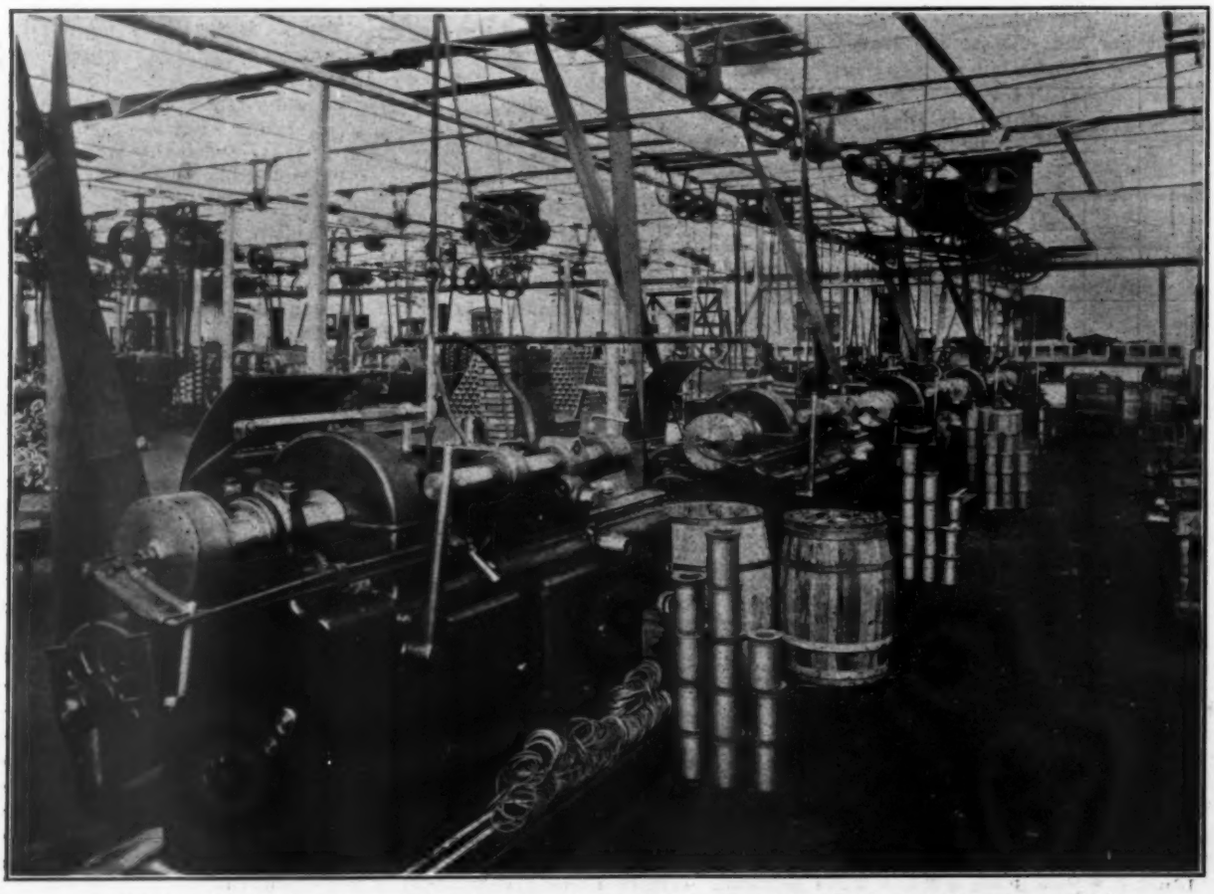
Energy Supply and Distribution.

Energy for lighting and power is obtained from the central-station lines of the Michigan Power Company, at 4,400 volts, three phase. New substation equipment is now being put in to take care of the full requirements of the plant. In the meantime old transformer substations and various temporary substations are being employed. The power circuits in the plant are all 440 volts, three phase. The lighting circuits are three-wire, 110-220 volts. In both the new and the old buildings the wiring for both the power and lighting circuits is now carried in iron conduit throughout.

In this last statement is represented a reorganization work of great proportions. The old buildings were formerly wired in no such up-to-date manner and when it was decided to put everything into conduit, in one department after another, the department of the chief electrician was increased to very considerable proportions. A. H. Croy is the chief electrician and under him are 40 men, including operators, maintenance and repair men and construction men.

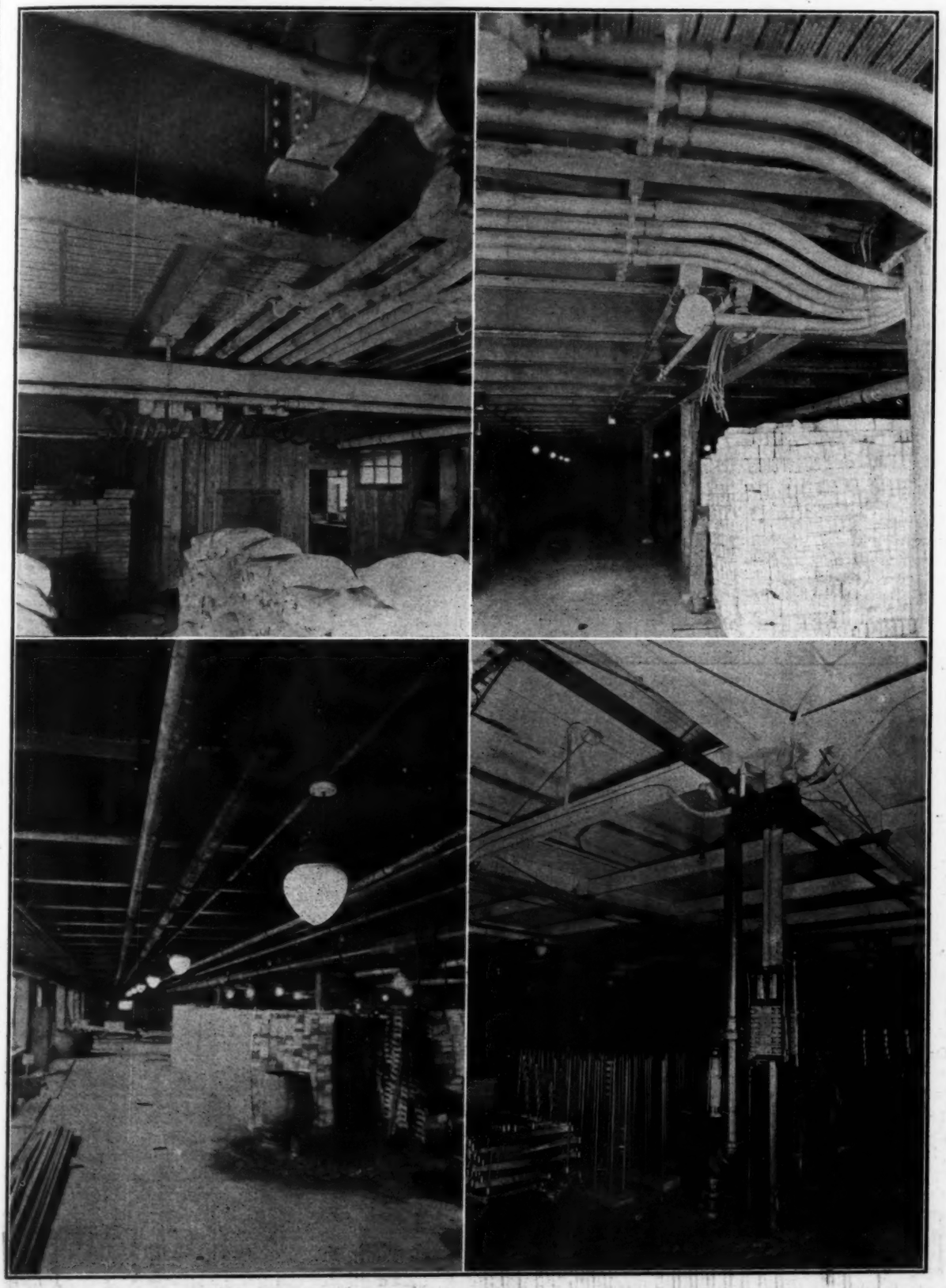
Rehabilitation of Electric Circuits.

During the change over Mr. Croy has been facing some



New Machine Shop in Reo Plant—Motors Are Connected to Shafting by Link-Belt Silent Chains Running in Oil.

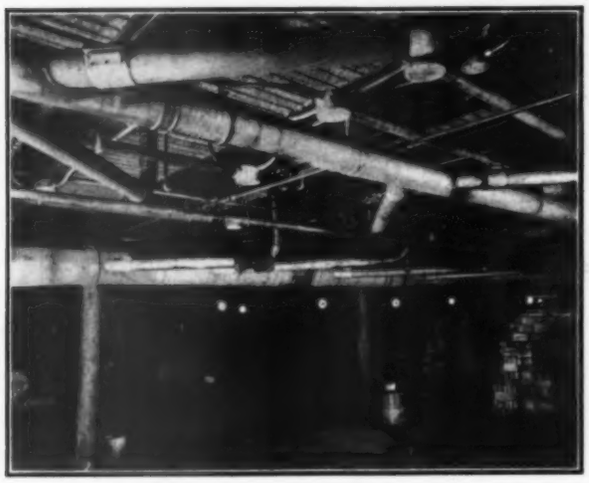
Views in Reo Automobile Company's Plant



Electrical Installation Views in Plant of Reo Motor Car Company.

View in Upper Left Shows Conduit Runs for Pyrometer Leads, View in Upper Right Shows Typical Conduit Construction, Lower Left View Shows a Typical Lighting Installation in Basement, Typical Lighting-Control Panel Shown in Lower Right.

rather difficult situations much more frequently than is the case in a plant new from start to finish, where things are standardized at the beginning. For months the work of changing the wiring in the old buildings into conduit



View of Conduit System In Basement Showing Use of Adapti Boxes.

construction of the latest style has been going on, and is nearly completed. But at the same time the requirements of shop production have put him in many a quandary. "Here today and there tomorrow" applies to many of the departments or groups of machines in a department. A certain run of material, we will say, has gone through a certain department. It may be sufficient for the time being, but space is valuable, machine tools are at a premium, and neither must be permitted to stay idle. Mr. Croy comes down in the morning and finds that some of the machines of the particular department have taken wing in the night. Or perhaps a complete rearrangement of the equipment has been made to adapt it to another class of work. Under any other than a modern and flexible system, this would entail an endless amount of rewiring.

And the one thing that has saved the electrician's department an untold amount of useless and time-consuming labor is the use of a readily adaptable conduit fitting. Up to this time several thousand Adaptiboxes have been put into service, and they are going into every part of the new construction lavishly. As a convenience in wiring, this line of fittings has worked out to great advantage. In the straight runs of conduit the wires may be drawn several hundred feet, if necessary. But where there are right-angle turns, dips and bends, as shown in one of the accompanying illustrations, the boxes are inserted at frequent intervals, the wires being sometimes cut to allow of short draws and then spliced in the boxes, which in this case are used as junction or "pull" boxes.

One of the illustrations shows the pipes carrying the pyrometer leads for the system of temperature measurement used in connection with case-hardening and tempering furnaces installed on the floor above. These two-inch pipes carry 20 No. 14 duplex wires each, and it would be impossible to make long pulls around these turns and through the curves and dips. As seen in the center of the illustration, a box was inserted in each pipe. The wires were cut to reach this point and there spliced to another length reaching to the corner of the little room in the background. Here the loose ends will be seen depending and these are ready to be spliced to another length making a right-angle turn with the room, the splices to be contained in another row of boxes at this point. In other words, splice and pull is the order in these circuitous routes.

Another illustration shows the same pyrometer-lead conduits at a point a little farther along, where one of the conduit turns at right angles and passes down the bay. At this right-angle turn, where there is also a change in level, two boxes are used one above the other. Part of the splices were made in the lower box and part in the upper one, and the turn made at the same time without difficulty. This view also shows the standard method of fastening the pipes to the ceiling. Still farther along, we see in another view the boxes inserted in the main conduit lines and the method of tapping from them the smaller conduits which carry the individual leads up through the floor to the pyrometers in the room above.

The approximate average load of the whole plant is 5,000 kilowatts, mostly represented by lighting and motors, of which latter there is a total of nearly 5,000 horsepower connected, with a 65 per cent load-factor. In addition, there are various electrical processes which require considerable energy, as for instance, the electric ovens for enameling, of which there are three, requiring 450 kilowatts for their operation; a conveyer enameling oven, requiring 250 kilowatts; electric arc-welding machines, etc.

Motor Drive.

In the older sections of the plant most of the machinery is under sectional drive, large sections being the rule. But in the newer shops group drive is employed almost exclusively. Each department has its own line shaft, transmission from the motor being by Link-Belt silent-chain drive, running in oil.

One of the illustrations shows a good example of the motor-driven sections. All the motors are 440-volt, three-phase, 60-cycle, principally General Electric and Western Electric makes. The largest motor is 150 horsepower, installed to drive a large air compressor. In the general machine shop alone, in the new plant, there are 33 motors, six of 75 horsepower, 22 of 50 horsepower, four of 25 horsepower and one of 35 horsepower.

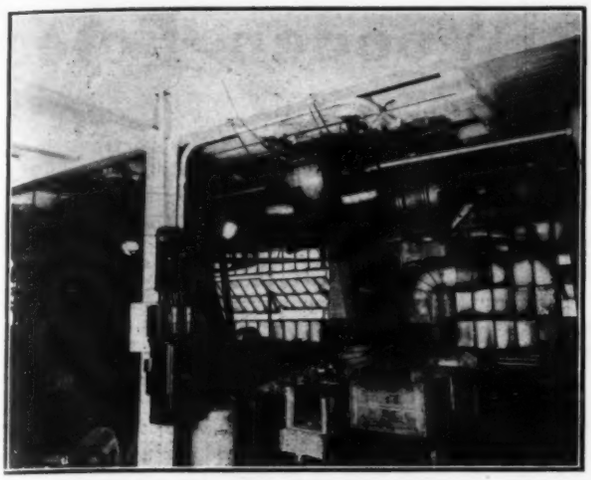
The standard Western Electric starting box is em-

Typical Lighting View in Reo Factory.

ployed, mounted on the walls or roof-supporting pillars. In one picture a typical motor installation is shown with starting box and conduit carrying the motor leads up to the ceiling and over to the motor, terminating in an Adaptibox fitting through which the leads are taken out and connected to the motor terminals. This particular motor is rated at 55 horsepower and drives a group of grinding machines.

Lighting Equipment and Circuits.

Gas-filled tungsten lamps are used almost exclusively



Motor Drive Line Shaft By Means of Link-Belt Silent Chain Running in Oil—This Type of Drive is Standard in Reo Plant.

throughout the plant. They are all 400-watt units, mounted in Harter fixtures. Cooper Hewitt mercury-vapor lamps are used in a few of the departments for special work. In one view is shown an example of bay lighting, through a single line of conduit, the lamp leads being taken out through Adaptiboxes. Another view shows a similar lighting arrangement in a basement.

Panelboards and the cabinets containing them are made at the Reo plant. This is done for the sake of economy at present, but later an attempt will be made to standardize upon one of the complete equipments now on the market. The cabinets are 40 by 16 by 6 inches and the boards are fitted with Trumbull panel units for 10 to 14 circuits. Economy fuses are standard throughout the plant and it has been demonstrated that a great saving has been made by employing them while their operation has been found in all respects entirely satisfactory.

One of the standard lighting panelboards is shown in one of the views. Above this is a 24 by 12 by 6-inch pull box from which two-inch feeder pipes are taken out right and left. Wires for the two adjacent bays are taken through 1.25-inch pipe leaving the top of the box. These turn and pass to a point in the middle of the bay and a right-angle turn is made through an adaptable fitting as shown, the conduit passing up to a smaller pull box located on the under surface of the sawtooth roof.

The same illustration also shows one of the special night lights suspended by a drop cord. These are on a separate circuit from the main lighting system, but the wiring for them is carried through smaller conduits, also provided with Adapti fittings.

In general the lighting mains are of 500,000 circular mils and the lamp circuits are usually arranged for two lamps to a circuit. The power mains are also 500,000 circular mils, with branches of No. 0000 and the circuit leads to the motor No. 00 for 75-horsepower motors and No. 0 for 50-horsepower motors.

Red-Cross Work of New York Girls Explained.

A record crowd attended the joint meeting of the New York Companies Section, National Electric Light Association, and the New York Electrical Society on Tuesday, April 17, at the Lighting Companies Building, New York, N. Y. More than 700 were present. Walter Neumuller presided. The speaker of the evening was Homer Croy, magazine writer and motion-picture expert. Chairman of various committees gave reports and Miss Clara Porter told of the work being done by the Red Cross Auxiliary of the section. After the meeting those present visited the Red Cross headquarters and inspected the work being done. The ladies gave an informal dance.

Girls of the New York Central Stations Who Have Formed a Red-Cross Auxiliary.

Butt Treatment of Wooden Poles

Valuable Report on the Preservative Treatment of the Butts of Poles for Overhead Electric Light, Telephone and Telegraph Lines, Extracted from a Recent Bulletin of the Iowa State College of Agriculture and Mechanic Arts

By A. B. CAMPBELL

THE principal reason for applying preservative treatments to poles is to make them offer a greater resistance to decay. There are other reasons which might be given, such as making possible the use of smaller poles, conservation of the natural forests, and the prevention of insect attack, but they all involve in some way the reason first mentioned. It may seem strange to think that any relation should exist between insect attack and decay, but some recent observations on pole lines, where considerable damage had been done by insects, indicate that sound poles are less susceptible to such damage than ones in which decay has started.

The life of untreated poles varies widely, so that only general results are available. This variation depends upon the kind and size of pole used and the local conditions under which it remains in service. For Iowa, the serviceable life of a 35-foot, seven-inch-top cedar pole is estimated by operating engineers to be about fifteen years. Chestnut, practically the only other kind of timber used in pole lines, is not as durable as either the northern white cedar or western red cedar.

The following, taken from "The Preservation of Structural Timbers," by Howard F. Weiss, illustrates very clearly the way in which preservative treatments accomplish their purpose.

"In brief, all fungi and bacteria which decay wood require certain amounts of heat, air, moisture and food in order to live. If one or more of these essentials can be eliminated, these organisms cannot live and hence wood will remain sound indefinitely. The basic problem, therefore, in any efficient preservative process is to accomplish this. Obviously a control of heat and air around structural timber set subject to decay is exceedingly difficult and generally impracticable. Hence a control of the moisture in the wood and the food of the fungus (which is the wood substance) are the two most practical lines of preventing attack. Wood kept constantly under water is too wet to permit the fungi to grow and hence will remain sound ad infinitum. Conversely, wood kept constantly air dry or drier contains too little moisture for fungus growth and will never decay—towit, the durability of furniture in dwellings, etc. All successful wood preservatives, therefore, either keep the wood comparatively dry or else poison the wood so that the organisms attacking it are killed."

Practically all of the poles which are given preservative treatments in this country are treated by either the brush, open-tank, or pressure process. The latter is sometimes spoken of as the Bethell or full-cell process. Each of these methods has disadvantages and advantages which make its use desirable under certain conditions.

The Brush Process.

The brush process consists in applying to the butt end of the pole one or two coats of hot preservative with a heavy brush. The temperature of the preservative should be from 180 to 200 degrees Fahrenheit and, if two or more applications are given, they should be at least 24 hours apart. The portion of the pole which is usually treated is from the butt end to a point about 18 inches above the future ground line.

In treating poles with the brush process it is very important that they should be well seasoned and that the butts should be carefully shaved so that there will be no dirt or loose pieces of bark to prevent a uniform penetration of the preservative into the pole. The depth to which the preservative enters the wood is considered a measure of the increase in the life of the pole which will be obtained through treating and, since the chief disadvantage

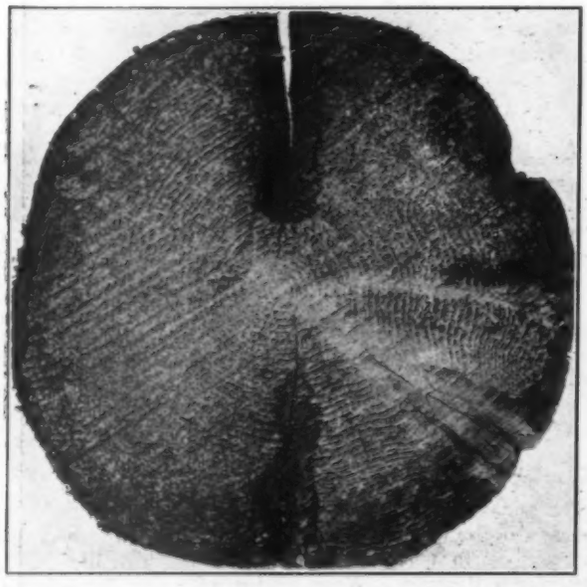


Fig. 1.—Cross Section of Pole Given a 15-Minute Immersion in Creosote at 180-220 Degrees Fahrenheit.

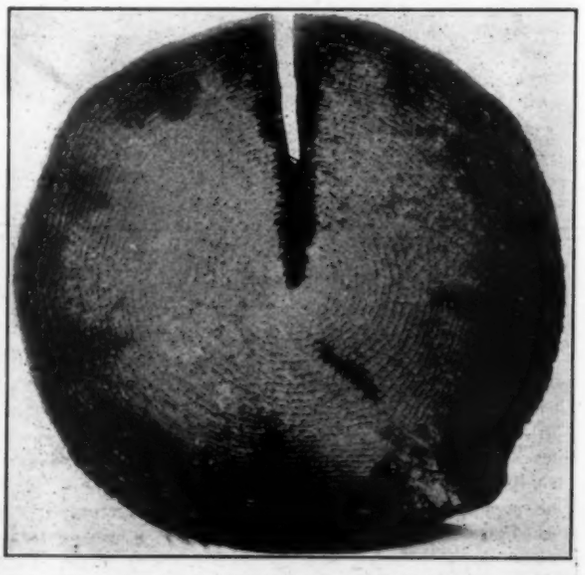


Fig. 2.—Cross Section of a Pole Given a Four-Hour Immersion in Creosote at 180-220 Degrees Fahrenheit Followed by a Two-Hour Immersion in Creosote at 112 Degrees Fahrenheit.

of the brush process is the lack of penetration, it is essential that all unnecessary resistance to the absorption of the preservative be removed. The uneven penetration sometimes found is due to pieces of bark which were not removed before the poles were treated. The advantages of the brush process are the low cost, convenience in applying, and the small amount of equipment necessary for this method of treatment.

The preservatives that are used most extensively with the brush process are creosote and several of the patented wood preservatives. Some of these patented compounds are coaltar products having properties similar to creosote, but are more expensive.

In regard to brush treatments, consisting of more than one application, it may be said that recent observations which have been made by engineers of the American Telephone & Telegraph Company indicate that poles treated with two coats are resisting decay much better than those which are given only one coat, while further observations indicate that very little, if anything, is gained by a third application of the preservative.

The cost of treating poles by the brush method will vary on account of the variation of the cost of preparing the butts for treatment, the cost of labor used, the kind of preservative applied, and the size of the pole. The cost of giving two coats will be less than twice the cost of one coat, because no preparation of the butts for treatment is necessary for the second coat, and frequently the second coat is applied to only a part of the surface covered by the first coat. Taking all the variable factors into consideration, the average cost for treating a six or seven-inch, 25-foot cedar pole will be between 20 and 30 cents for the first coat. This is based on cost data secured from several operating companies in Iowa. The amount of preservative necessary to treat a 35-foot, seven-inch-top pole with two full coats is approximately three-fourths of a gallon. If only a partial second coat is given, one-half gallon of preservative per pole may be sufficient.

A precaution which should be taken when treating poles by the brush process is to keep flames from an open fire from reaching the preservative while it is being heated. When the preservative has ignited, the flames are very difficult to extinguish. Some damaging fires and painful accidents have resulted from this cause.

The Open-Tank Process.

In the open-tank process, the butts of the poles to be treated are submerged in the preservative for different lengths of time and under various conditions. In order that uniform results might be obtained, the Western Red Cedar Association has adopted specifications which practically standardize three open-tank methods of treatment. These are known as Treatment "A," Treatment "AA," and Treatment "B."

The following statements relative to the three open-tank methods just mentioned, are taken from the specifications which have been adopted by the Western Red Cedar Association for butt-treating poles in open tanks. The Northern White Cedar Association has not formally adopted any set of specifications for open-tank treatments but it recognizes and recommends those adopted by the Western Red Cedar Association.

"Treatment 'A.'—This provides for a continuous submersion in hot Carbolineum for a minimum duration of 15 minutes when the temperature of the atmosphere is 70 degrees Fahrenheit or higher. If the atmospheric temperature is below 70 degrees Fahrenheit, the minimum period of continuous submersion shall be increased proportionately.

"The preservative shall be heated to a temperature of 215 degrees Fahrenheit at least once every four hours of treatment, and shall not be allowed to fall below 180 degrees Fahrenheit, or reach above 230 degrees Fahrenheit.

"Treatment 'AA.'—This provides for a continuous submersion in hot creosote for a minimum duration of 15 minutes when the atmospheric temperature is 70 degrees Fahrenheit or higher. If the atmospheric temperature is below 70 degrees Fahrenheit, the minimum period of continuous submersion shall be increased proportionately.

"The preservative shall be heated to a temperature of 215

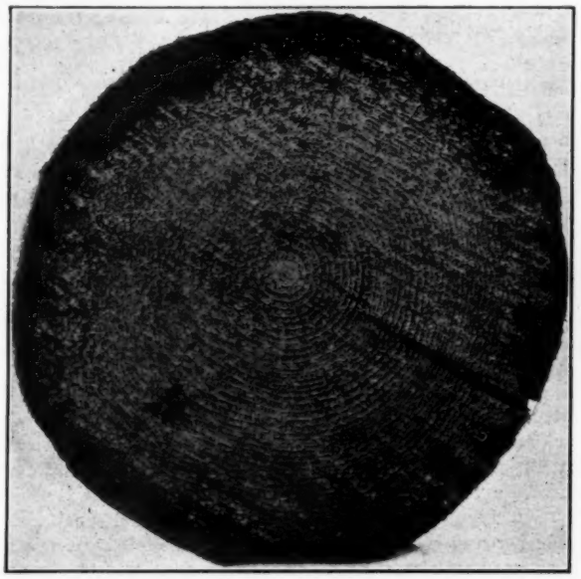


Fig. 3.—Cross Section of Pole Given a Four-Hour Immersion in Creosote at 180-220 Degrees Fahrenheit.

degrees Fahrenheit at least once every four hours of treatment, and shall not be allowed to fall below 180 degrees Fahrenheit, or reach above 230 degrees Fahrenheit.

"The creosote shall be a coal-tar distillate obtained entirely from coal-gas or coke-oven tar and must not contain any admixture of any other tar, oil, or residue obtained from petroleum or any other source, including coal-gas tar or coke-oven tar. The oil must be completely liquid at 100 degrees Fahrenheit and be free from suspended matter.

"Treatment 'B.'—This provides for a continuous submersion in alternately hot and cold creosote for a minimum duration of six hours. The duration of the treatment shall be divided between a hot and cold bath. The poles shall remain in the hot bath for four continuous hours, after which they shall be transferred to the cold bath in which they shall remain for two hours.

"The preservative constituting the hot bath shall be heated to a temperature of 212 degrees Fahrenheit at least once every four hours and shall not be allowed to fall below 180 degrees Fahrenheit or reach above 230 degrees Fahrenheit. The temperature of the preservative constituting the cold bath shall not exceed 112 degrees Fahrenheit at the conclusion of the treatment."

Treatments "A" and "AA" require no explanation further than the specifications covering them. They are alike in every respect except in the preservatives used. Treatment "A" calls for the use of Carbolineum, while Treatment "AA" calls for creosote. Treatment "B" differs from those just mentioned in that the pole is first subjected to a hot preservative and then immediately to a cold one. Where Treatments "A" and "AA" call for a submersion of 15 minutes, Treatment "B" specifies that the minimum period of submersion shall be six hours. This includes the submersion in both the hot and cold preservative.

The purpose of the alternate hot and cold treatments is to obtain a deeper penetration of the preservative into the wood and thus obtain a maximum increase in length of life due to preservative treatment. When the butt of a pole is submerged in a hot preservative, the temperature of the wood is raised above normal, thus expelling a portion of the air which is

contained in the wood cells and forming a partial vacuum. When the pole is suddenly submerged in the cold bath, the preservative is forced into the pole, as it were, by atmospheric pressure. The extra length of time required and the additional labor, equipment and preservative used in giving this kind of treatment, will increase the cost where poles are treated under the specifications for Treatment "B." This will have a tendency to limit this form of treatment to only such poles as will be used in the most substantial type of construction.

Some idea as to the relative merits of the methods used in the open-tank process may be obtained by referring to Figs. 1, 2 and 3. Fig. 1 shows the penetration of the preservative obtained by Treatment "AA." Fig. 2 shows the penetration obtained when the pole is given Treatment "B."

The theory upon which Treatment "B" is based is substantiated by comparing Figs. 2 and 3. The pole shown in Fig. 2 was given the alternate hot and cold baths as specified for Treatment "B." The pole shown in Fig. 3 was submerged for four hours in the hot bath only.

The open-tank methods of treatment are practiced by the pole companies having very large pole yards that are centrally located, and by some of the large operating companies who distribute their poles principally from one or more permanently located pole yards. In order to treat poles properly by these methods, a considerable amount of heavy equipment is necessary. Such equipment is not easily moved from one location to another and is therefore installed permanently. By operating an open-tank treating plant in connection with large pole yards, it is possible to keep the plant in continuous operation, and thus reduce the cost of treating by open-tank methods to a minimum.

Some operating companies having interests widely distributed have a semi-portable open-tank treating plant, which may be shipped from one place to another. These plants are of small capacity, but in treating large quantities of poles a small force of men may be kept continuously at the work. Very satisfactory results, both in treatment and in cost, are obtained from open-tank treating plants of this character.

Pressure of Full-Cell Process.

The Bethell or full-cell process consists in forcing the preservative, which is creosote oil, into the wood under pressure. The entire pole is placed in a cylindrical air-tight tank which contains the preservative, and a pressure of from 100 to 180 pounds per square inch applied.

While this process is used extensively for treating crossties and various other kinds of timbers, it is used very little in this country for the preservative treatment of poles. It being a pressure process, the complicated equipment necessary adds to the expense of treating. The Bethell process for pole treating is rarely justified, except when the first cost of the pole is low and life of an untreated pole is short. Such conditions are sometimes encountered when using some of the pines in localities where climatic conditions are very favorable to decay.

Preparation of Poles for Treating.

The importance of having poles well seasoned before butt treatments are given cannot be over emphasized. If treatments are given to partly seasoned poles, checking may result; and a check which occurs after treatment and which extends beyond the penetration of the preservative into the pole, partially does away with the advantage gained by treating. This is because a surface of untreated wood on each side of the crack is exposed to the action of decaying fungi. Fig. 3 illustrates this point. It will be noticed that the check extending nearly to the center of the pole may afford an opportunity for decaying fungi to gain an entrance to the untreated portion of the pole. Thorough seasoning is not so important if the treating is to be done by the pressure process.

In order that the process of seasoning may be standardized, the Western Red Cedar Association specifies that poles, if "properly piled for seasoning for a period of four seasoning months, shall be considered seasoned. In arriving at a seasoning month, the calendar months shall be rated as follows:"

January	equals	1/8	seasoning	month
February	"	1/8	"	"
March	"	1/4	"	"
April	"	1/2	"	"
May	"	3/4	"	"
June	"	1	"	"
July	"	1	"	"
August	"	1	"	"
September	"	1	"	"
October	"	3/4	"	"
November	"	3/8	"	"
December	"	1/8	"	"

Cost of Treatment.

The open-tank treatments are more expensive than the brush methods, but it should be kept in mind that a deeper penetration is secured when poles are given these treatments.

The following table, issued by Page & Hill Company, Minneapolis, shows the cost of northern white cedar poles, cost of butt treatment by open-tank process, per annum cost of poles in line, and number of years added life necessary to pay entire cost of treatment. Prices are f. o. b. Iowa and Illinois common points:

Size of pole	5"20'	5"25'	6"25'	6"30'	7"30'	6"35'	7"35'
Price of pole f. o. b. common points in Iowa and Illinois rate of freight	$.90	$1.28	$2.25	$3.90	$5.35	$5.85	$9.15
Cost of putting in line, including shaving, but exclusive of painting and stepping	.72	1.54	1.54	2.17	2.17	3.38	3.38
Total cost in line	$1.62	$2.82	$3.79	$6.07	$7.52	$9.23	$12.53
Using U. S. average twelve years life.—Per annum cost of pole in line	.135	.235	.315	.505	.626	.769	1.04
Cost of butt treatment accoriding to Specification "A"	.45	.55	.90	1.10	1.25	1.35	1.50
Cost of butt treatment according to Specification "AA"	.35	.40	.70	.85	1.00	1.05	1.20
Cost of butt treatment according to Specification "B"	.....	.....	1.30	1.85	1.95	2.05	2.35
Number of years added life necessary to pay entire cost of treatment				Years			
Specification "A"	3.3	2.34	2.85	2.17	2.	1.75	1.44
Specification "AA"	2.59	1.7	2.27	1.68	1.6	1.36	1.15
Specification "B"	.....	.....	4.12	3.7	3.12	2.66	2.26

One operating company reports the cost of treating by the open-tank process with semi-portable equipment at 75 cents per pole. In this case the butts are submerged in hot Carbolineum 20 to 30 minutes and then dipped in cold Carbolineum for two minutes.

The tank in which the hot treatment is given is five feet in diameter and nine feet high. Ten poles are treated at one time. The cold treatment is given in a tank three feet in diameter and nine feet high. Each pole is given the cold treatment separately. The poles are distributed by automobile truck.

No specific data are available as to the number of years which may be added to the life of poles through treating, but reports on inspections made on the Warren-Buffalo and Newton-Poughkeepsie lines of the American Telephone & Telegraph Company may be summarized as follows:

Method of treatment	Reduction in circumference at ground line after 5 years of service.	Average percentage of poles showing decay after 8 years of service.
Tank-treated with creosote	Not noticeable	1.5
Tank-treated with zinc chloride		59
Brush-treated with creosote	.06 inch	45
Brush-treated with Carbolineum	.09 inch	47
Untreated	1.03 inch	100

Above information obtained from Page & Hill Company, Minneapolis.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

Kansas City Company Establishes Three-Cent Cooking Rate—Other Rates Reduced.

The Kansas City Light & Power Company, Kansas City, Mo., will put into effect May 1 a cooking rate of three cents. This will become operative on the same day as the new schedule fixed by the Public Service Commission and accepted by the company. The cooking rate is entirely voluntary by the company; it was not mentioned in the findings of the Commission.

The company will measure the energy used for cooking on a separate meter. A minimum of 80 cents on the cooking schedule will be required; the present minimum on the lighting rate is 50 cents.

The company announced that because of the reduction made by the Commission, it was necessary to increase consumption of electricity, as well as to reduce expenses by economical management. The first day after the cooking rate was announced, the company's retail store was flooded with customers for stoves.

An announcement regarding new rates was published in the papers and shows the good faith of the company, which has repeatedly inferred that if electricity could honestly be furnished any cheaper than its own rates, it would make such lower rates. The present announcement is expected to have some effect on the local agitation for a municipal plant; it will certainly offset any complaint that Kansas City, Mo., is not getting favorable rates on electricity.

The company announced further that it would voluntarily reduce lighting rates, as the number of consumers increased. It now has 45,000 customers; when the number reaches 60,000, the eight-cent rate set by the Commission, will be reduced to seven cents; and when consumers number 75,000, the rate will be six cents.

The company estimates that the six-cent rate will be equivalent to a rate of 4.9 cents, because of the discount of five per cent, and the privilege of returning lamps for free renewal, or renewal at a special rate.

How the Milford Company Increased its Power Load.

How the Milford (Mass.) Electric Light & Power Company increased its power load 210 per cent in one year was the subject of a recent paper by LeRoy Braisted, its power engineer.

The first of 1916 a power survey was made, all plants not then having complete electric drive being listed as good prospects. Data were gathered relating to steam equipment, the manufacturer's attitude toward central-station service, and what steps, if any, had already been taken to secure the business.

To this were added accounts of interviews with the proprietors of the plants, from time to time.

The first step in the active campaign for the business was the attempt to create a desire to consider central-station service. The manufacturer was shown that his manufacturing costs were probably made up about as follows: wages, 19.2 per cent; saalries, 5.2; materials, 65.7; miscellaneous, 7.4; power, 2.5 per cent.

This indicates that power is one of the smaller items for consideration, though important.

A shoe-findings manufacturer who was approached was shown that he could save $1,000 per year by installing motor drive. He was guaranteed that his bill would not exceed a certain figure, and forthwith contracted for service.

This instance served as an entering wedge, and other local manufacturers quickly followed. In each case the bill for energy has been in accordance with the advance report submitted by the central station; hence there has been no cause for dissatisfaction. It is recognized that only by a close checking of reports with actual experience will a state of satisfaction be established, resulting in a good advertisement and an incentive to other manufacturers to "go and do likewise."

Uniforms for Meter Readers Improve Character of the Service.

While several of the large central-station companies have found it desirable to equip meter readers with uniforms, the Rockford (Ill.) Electric Company, serving a community of about 50,000 inhabitants, had no precendents to guide among companies of this size, in adopting this innovation.

As shown in the accompanying illustration, each meter reader has been provided with a dark-tan woolen uniform, and cap to match. The letters "R. E. Co." are sewed across the front of the caps and also on the edge of the upper pocket of the coat.

Speaking of the results derived, C. A. Carter, in charge of the meter department, says: "The uniform serves the purpose, first of giving the customer a better knowledge

Meter Readers of Rockford Electric Company in Uniform.

of who the man is who enters the premises, with just a glance at his suit, and after becoming acquainted with the appearance of the uniform, the customer will be more ready to allow a man entrance, thus saving time, particularly in reading. Second, the standard of dress and neatness of appearance speaks very well for the company, no matter in what capacity it is operating; in fact, the boys have received numerous compliments along this very line from the public."

One noticeable advantage has been the more dignified attitude assumed by the boys since wearing uniforms.

Electric Baking Adopted by St. Louis Seminary.

Saint Stanislaus Seminary, located about 1.5 miles from Florissant, St. Louis County, Mo., has recently installed electric baking ovens which are giving entire satisfaction. The installation consists of three ovens with four shelves each, the dimensions of each oven being 50 by 35.5 by 56 inches, and the dimensions of each shelf being 30 by 38 inches.

These bake ovens are similiar in construction to the ordinary gas oven. The heating units, which are of the grid type, are located in the base. The air is heated at this point, passes up the flues in each side of the oven and out over each shelf. This causes an even distribution of heat throughout and results in uniform baking.

The ovens are constructed of heavy galvanized sheet iron on an angle-iron frame. All walls are double and have heat insulation three inches thick. Each shelf has a heat insulated door which opens downward and forms a shelf when open. The door when closed is held by a springless latch.

To heat up the three ovens to 480 degrees Fahrenheit requires 90 minutes, and 60 kilowatt-hours of energy. Time required for each baking is from 30 to 50 minutes depending on the sizes of loaves. One hundred loaves is the limit capacity of each oven.

The first baking in these ovens was done on February 5, 1917, by Brother Terry, who has been the baker at the institution since 1898, using the ordinary brick ovens. In expressing an opinion of electrically baked bread, he says "It could not be better, and is far superior to the old method."

The heating and cooking installation at the Saint Stanislaus Seminary is expected to be the largest in this country, though it is not nearly complete as yet. It is contemplated that everything at the institution which requires heat or power will be operated electrically. Additional buildings will be erected to provide for proper distributing system, meters, switches, etc. Energy is supplied by The Electric Company of Missouri.

Louisville Company Reaping Benefits from Trial Installations by Many Power Contracts.

Recent contracts secured by the Louisville Gas & Electric Company for central-station service total 1,000 horsepower, while for the immediate future prospects are for closing with consumers who will take at least 500 horsepower, and indications are for subsequent contracts which will practically double this amount of business.

In several of the contracts closed the company is reaping the benefits of experimental installations made some time ago, in line with the principle of letting a prospect try out central-station service. One of the things, of course, that is working in favor of the central-station company is the high price of coal and the likelihood that the costs will be advanced still further. Where it used to be the case that the prospective user of central-station service had to be sold on the basis of convenience, it is now often easily possible to show him that the saving on his coal bill would in due time pay for the cost of his installation.

The Wilson Furniture Company, a woodworking plant, has displaced a steam plant with 125 horsepower in motors.

The Louisville Woolen Mills has provided for central-station service and will install from 250 to 300 horsepower in motor, 12 altogether, ranging from five to 40 horsepower.

A breakdown of the steam engine of the National Tobacco Works, of the American Tobacco Company, at Louisville, gave the Louisville Gas & Electric Company a 300-horsepower contract. The company did some quick work, extended its lines, erected poles and transformer platforms and installed two large transformers and had the plant operating on central-station service in less than a day. The plant had already been using two-phase motors, and all that was necessary was to bring service to the switchboard. A contract for one year was signed and the company will probably throw out two 250-kilowatt generators direct-connected to high-speed steam engines.

Another contract involves a connected load of 200 horsepower with prospective addition in the near future. This is in the Bradas & Gheens Company, a candy manufacturing plant and was in part the result of a trial installation of a 20-horsepower motor for a mixer a year ago. This installation involves dismantling of the old direct-current equipment, including a 200-horsepower steam engine and a 150-horsepower generator.

The Charles Stoecker Tanning Company has contracted for service involving 175 horsepower and has purchased 20 motors which are being installed. Two old steam units will be thrown out and central-station power will be used exclusively. The company, in addition to the power contract, has contracted for 10 kilowatts of lighting installation. The pioneer woodworking plant in the Louisville section to make use of central-station service, the Turner, Day & Woolworth Handle Company, has added an additional 50-horsepower motor to its equipment, using it to operate a circular saw. This company has been a central-station patron for eight years.

The Louisville Cotton Mills, one of the best equipped plants in the Ohio Valley, has contracted for three 10-horsepower and two 15-horsepower motors and for central-station service to operate additional equipment and is contemplating discontinuance of its isolated power plant, including a 250-horsepower Corliss engine and converting to motor drive. The wiring plans for installation of this equipment are designed to take care of 350 horsepower of additional motors and for additions to the switchboard equipment to take care of the entire mill at a later date, the entire load to run to 1,500 horsepower.

Easton Company Secures Additional Power Business.

The Pennsylvania Utilities Company, Easton, Pa., is building a 33,000-volt transmission line to the Analomink Paper Mills, at Stroudsburg, Pa., and the paper company is adding 600 horsepower to its present equipment of 250 horsepower. A new line is being extended to Shawnee to serve the famous Buckwood Inn and the surrounding summer colony of cottages. This service will add a load of about 75 kilowatts. The Pennsylvania Cement Company has nearly completed the installation of 2,000 kilowatts in motors, which will bring the total installation to 3,000 kilowatts. This mill is supplied from a 33,000-volt line from Easton, Pa.

To Electrify Equipment on 10,000-Acre Farm in the West.

The Washington Water Power Company, of Spokane, Wash., has closed a contract with F. M. Rothrock, owner of a 10,000-acre farm west of Sprague, Wash., to install complete electric equipment for all purposes on the farm. The equipment will include three 15-horsepower motors to run the pumps for the irrigation project, a 10-horsepower motor for the chop mill, a smaller motor for a wood saw, and a portable motor for general purposes.

All of the farmhouses, bunkhouses, barns, feeding sheds and feed cellars are to be electric lighted. The entire equipment will cost about $2,000, and will be the largest and most complete on any farm in the Northwest.

The Customers' Information Book as an Aid in Improving Conditions.

For a number of years it has been the practice among a number of the utilities operated by H. M. Byllesby & Company, Chicago, Ill., to issue information books to customers, explaining the policy of the company, giving information regarding all classes of service, rates, etc. These little booklets have been of such aid in anticipating complaints and explaining many of the apparent complications of central-station rates and service that recently a standard handbook has been adopted for all Byllesby properties, prepared by the publicity department. Of course, the booklets differ in text in those sections describing local rates, giving telephone numbers, etc., but in general all are alike.

The introduction, which explains the company's policy, is indicative of the present attitude of modern central-station companies and is abstracted herewith:

"This little book is intended to place in your hands information useful toward the satisfactory employment of electric service.

"The public and the company are partners in the advancement of the comfort, convenience, growth and prosperity of the community.

"Our desire is to earn the right to reasonable compensation in exchange for a service necessary to Oklahoma City and its people, and to earn the wage fairly by honest service pleasantly and cheerfully rendered.

"Our company is a monopoly only because experience has shown that one public utility company can give better service at a lower price than two or more companies representing useless duplication of investment upon which double interest, taxes, depreciation and insurance must be paid, out of the rates charged.

"We want to be fair to you and we want you to be fair to us.

"Our customers and the general public are always welcome at our office.

"The general manager endeavors to receive personally all who wish to see him. For routine business transactions, however, proper departments are maintained to meet the requirements of customers in the quickest and most efficient manner." The booklets also explain how to read meters, etc.

Electric Cooking School of St. Louis Company a Big Success.

As mentioned in our issue of March 24, the Union Electric Light & Power Company, St. Louis, Mo., recently established an electric cooking school embodying many useful features. Not only were lessons given free by Mrs. Margaret M. W. Winn, a domestic science expert, but in addition the company agreed to pay $7.50 in cash to each of those who completed the course of 10 lectures. In addition to offering a strong inducement to housewives to increase their own efficiency in cooking, and also the efficiency of their cooks by educating them in the principles of electric cooking, the cooks who wished to improve their time on their own accord were enabled to do so under the electric company's plan. The company agreed also to present diplomas to those who developed to be the best cooks and the names of those receiving diplomas are kept on file for the benefit of the cooks themselves as well as for those who inquire for their services.

Of course the purpose of the school was to sell electric ranges by inference. The company planned eight advertisements in order to secure the necessary enrollment but on the day following the first insertion the company received 700 applications and within a week 1,086. After the appearance of the second advertisement the company had to run another notice announcing that the enrollment was filled.

The accompanying illustration shows a class in session. There are 48 members in each class, 12 of whom do the actual cooking. Therefore every fourth lesson a lady does actual cooking and during the other three lessons she listens to lectures and watches others cook. Classes are held twice each week.

Electric Cooking School at St. Louis in Session.

In order to popularize electric cooking and instruct prospective users in the operation of the electric range, the Union Electric Light & Power Company established a cooking school in its office building, under the direction of a well-known domestic-science expert. An advertisement announcing the school resulted in over 1,000 enrollments. The Union Electric Light & Power Company pays each woman who attends this school $7.50.

ELECTRICAL CONSTRUCTION

A Department Devoted to Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

Flood-Lighting a Building by Means of Angle Reflectors.

By Leo Dolkart.

The large number of buildings, statutes, etc., now lighted by means of flood-light projectors leads one to think that flood lighting is impossible without such special equipment. Herewith is shown, however, a building that is not flood lighted in this manner. It is illuminated by 40-watt lamps, each provided with an angle reflector. There are only 23 of these lamps used to light the entire building fronts.

The building is 44 feet wide and 76 feet long and is located on a prominent corner in Moline, Ill. Owing to its location it was impossible to illuminate the building by flood-lighting projectors, particularly since the other side of the street is occupied by the main right of way of the Chicago, Rock Island & Pacific Railroad.

The wooden sign extending along the top of the building projects about a foot from the front. The reflectors, in turn, project several feet from the sign. It was imperative to study the distribution curve of the reflectors used in order that this distance, as well as the distance between the reflectors, could be correctly determined. The reflectors used were of the porcelain-enameled angle type and were made by the Ivanhoe-Regent Works, of the General Electric Company. The lamps used were of the 40-watt Buckeye Mazda type.

A reference to the illustration will show how uniformly the sign as well as the building itself are illuminated. The light streaks at the right as well as toward the bottom of the picture were caused by headlights of passing automobiles. The light streaks near the top were caused by new trolley wires which reflected the light from a nearby street lamp. The negative for this picture, which was taken by the author, was exposed ten minutes.

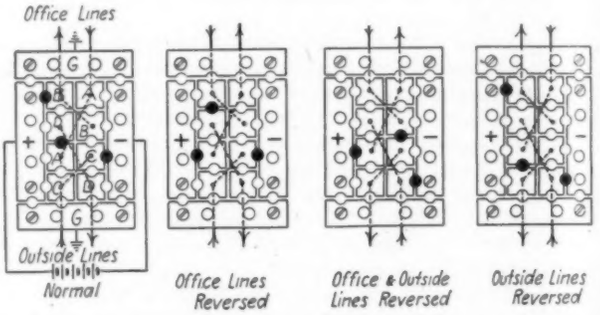
Flood-Lighting of Moline Building by Means of Angle Reflectors.

While as a general rule flood-lighting projectors are more economical to install, as far as wiring is concerned, the writer believes that often occasions arise where angle reflectors would prove much more economical when total cost of installation as well as energy consumption is considered. It is very doubtful whether flood-lighting projectors could have been installed to give such uniform results, not only with the same energy consumed, but even with a 50 per cent increase. Another objection to flood-lighting projectors, which is not present in this case, is the very high intrinsic brilliancy of the sources of light. If flood-lighting projectors had been used, the lamps would have been much more powerful and if placed across the street from this relatively low building would have proven objectionable because of serious glare when viewed by passers-by.

A Convenient Terminal and Testing Pin Switch.

By George A. Broder.

In electric signal systems or other similar work it is very necessary in some instances and always very convenient to have a combination pin switch and connection block in the circuit, whereby the outside and inside lines or both may be reversed and either side of each circuit or battery grounded.



Convenient Terminal and Testing Pin-Switch Block, Showing a Few Typical Combinations Obtained.

Such a combination connection block is shown in the accompanying sketch and can easily be made from a few brass or copper strips, about one-half inch wide and one-eighth inch thick, that are mounted on a slate or marble base. Tapered holes one-quarter inch in diameter are drilled as shown and reamed to fit the one-quarter-inch pin plugs that form the connections between the different terminal strips. Long screws or studs pass clear through to the back of the board where washers and nuts hold the plates and serve to fasten the wires firmly. These studs may be lettered A, B, C, D, etc., as shown for convenience in plugging.

By following out the circuits through the pin plug and wires it will be seen that many combinations of 10 times desired can be obtained by simply changing the position of the plugs. The outfit may, in fact, be wired to meet almost any special condition that may arise.

Stripping Rubber Insulation from Stranded Wire.—In stripping the insulation from stranded wire, much trouble is experienced by some electricians in removing all of the rubber from between the strands. This trouble is overcome by the following method of stripping, which I find especially useful for stranded wire: With the knife cut around the braid and rubber at the desired point, taking care not to cut into the copper strands. Now slit the insulation from this cut to the end of the wire and open the entire insulation by rolling it back from the slit. This leaves the wire clean and bright. A. P. Mills.

Brush Friction, Contact Drop and Pressure

A Study of the Coefficient of Friction and Contact Drop of Carbon Brushes; Tests of These Two Characteristics and How They Are Affected by Variation of Brush Pressure

By E. H. MARTINDALE
Chairman, Industrial and Domestic Power Committee, A. I. E. E.

This is the third of a series of 14 articles dealing with the solution of commutator and brush troubles. The first two articles published in the issues of March 24 and April 7, were devoted to the development of carbon brushes and brush composition and characteristics. The present article shows how brush friction, contact drop and pressure can be properly balanced so as to give greatest economy and the best possible all-around service. The remaining articles, to appear at intervals of two weeks, will show how other properties of brushes are used in solving commutation problems.

THE COEFFICIENT of friction of a carbon brush is the ratio of the frictional pull of the commutator on the brush to the pressure of the brush on the commutator. From the standpoint of the economical operation of motors and generators, the coefficient of friction of carbon brushes is one of the most important considerations. Few engineers, unless they have studied the problem, have any idea how great an annual loss they are absorbing when they use brushes with a high coefficient of friction.

Examples of Wastefulness of High Brush Friction

Let us determine the brush friction on a 220-volt 100-kilowatt generator with a current density of 30 amperes per square inch of brush area, a brush pressure of two pounds per square inch and a commutator speed of 3,500 feet per minute. This machine delivers approximately 450 amperes, which at 30 amperes per square inch requires 15 square inches of positive brush area and the same of negative, or a total of 30 square inches. At two pounds per square inch pressure, we have 60 pounds total brush pressure on the commutator.

The coefficient of friction varies from a little above zero to over 0.9. Let us assume 0.2 as a low friction and 0.7 as a high friction. As one watt is equivalent to 44.26 foot-pounds per minute, we can express the friction loss by the following formula

$$W=\frac{A\times P\times F\times S}{44.26}$$

where W is the loss in watts, A is the total area of brush contact in square inches, P is the brush pressure in pounds per square inch, F is the coefficient of friction of the brush, and S the peripheral speed of the commutator expressed in feet per minute.

Substituting the values given above for A, P and S, we have

$$W=\frac{30\times 2\times F\times 3{,}500}{44.26}=4{,}744\times F.$$

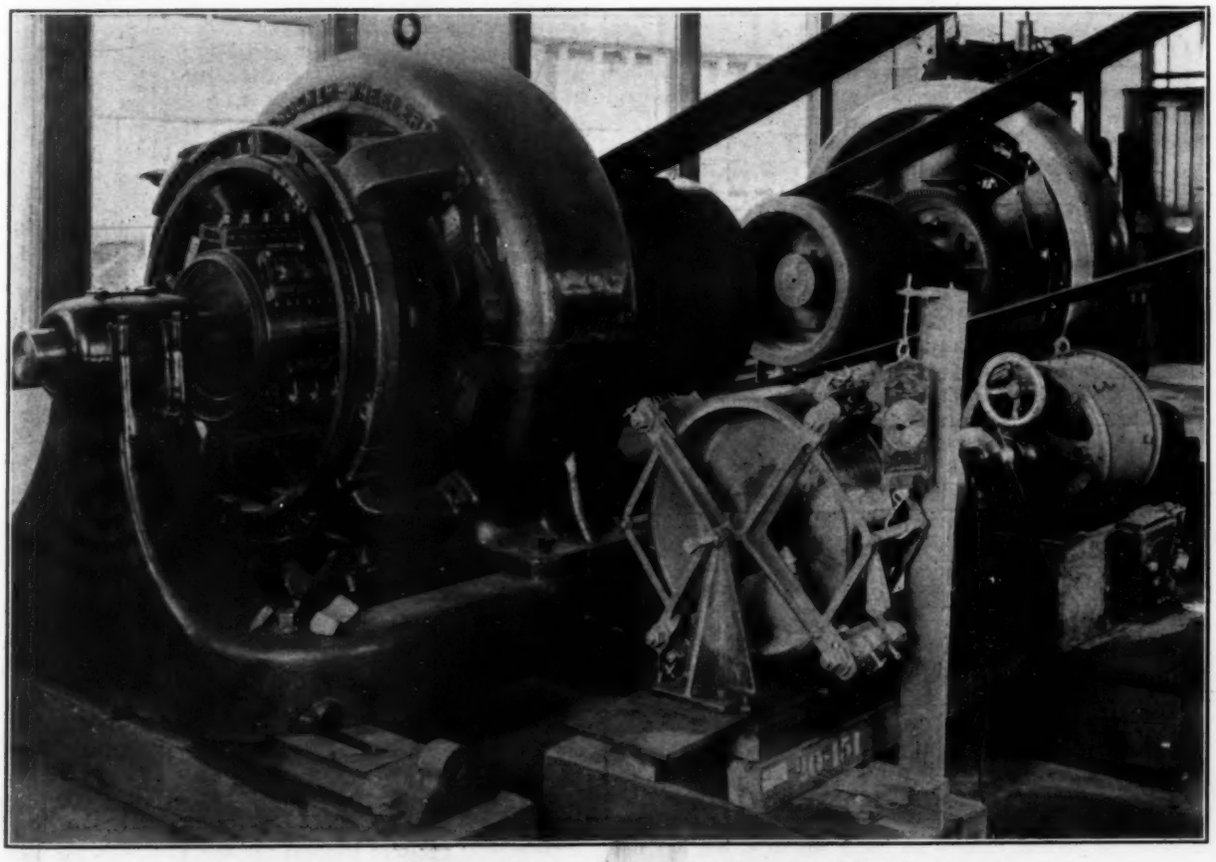


Fig. 1.—In the Right Foreground is a Machine for Determining Coefficient of Friction.

When F is 0.7, W=3,310. When F is 0.2, W=949. The difference is 2,361 watts, or 2.36 kilowatts, or nearly 2.5 per cent of the generator capacity. Assuming a 10-hour day, a 300-day year and a power cost of one cent per kilowatt-hour, which is very low, we find the annual loss with the 0.7 friction brush is 3.31×300×10×.01=$99.30 and with the 0.2 friction brush is 949×300×10×.01=$28.47. The unnecessary loss is more than $70.00 per year, or enough to pay for two or three sets of the low-friction brushes.

If we work the same problem out for a 100-kilowatt, 110-volt generator with peripheral speed or 4,000 feet per minute, brush pressure of five pounds per square inch, and a power cost of two cents per kilowatt-hour, we find the loss reaches the startling sum of 19 per cent of the generator capacity, or an annual loss of $1,140.00 with the 0.7 friction brush and 5.4 per cent or $325.00 for the 0.2 friction brush, a possible saving of over $800 per year.

This last example illustrates an extreme and yet not an infrequent condition. Such severe service generally results in such heating that the machine is unable to carry its full load.

On many machines the brushes must have abrasive action to keep down the mica and abrasive action cannot be obtained without high friction. This is one of the main reasons why mica should be undercut wherever possible, as a brush can then be selected which will have a low friction. Where oil dirt is present to such an extent that short-circuits are apt to occur in slotted commutators, it is advisable to paint them with an air-drying, insulating varnish and then remove the varnish from the surface of the bars by the use of a commutator stone.

When an operator prefers not to undercut his mica and can give daily attention to each machine, it will be found more economical to use a commutator stone to keep down high mica than to try to keep it down by the use of a high-friction abrasive brush.

Tests and Laws of Brush Friction.

In the right foreground of Fig. 1 is a machine used for determining coefficient of friction. It consists of a ring which can be driven by a variable-speed motor at any peripheral speed from 500 to 8,000 feet per minute. The brush holders, which have springs that can be adjusted to any desired pressure, are mounted on a frame supported on sensitive pin bearings. This frame is prevented from rotating by the spring balance. From the reading of this pull the coefficient of friction is readily computed.

According to the laws of physics, the coefficient of friction between two materials is independent of pressure, but this law does not seem to hold good for brushes as practically all grades show a difference in coefficient of friction with a change in pressure.

Fig. 2 shows the coefficient-of-friction curves of a very soft and a very hard brush at pressures of 2, 4 and 6 pounds per square inch. The hard brush is almost pure carbon, containing only 0.1 to 0.3 per cent impurities and has a very low friction. The soft brush has 10 to 12 per cent impurities, which give it high abrasive qualities and a high friction. The coefficient of friction of a soft brush decreases with increased pressure, probably due to the more rapid mechanical wear of the brush, which acts as a graphite lubricant on the commutator. With the hard brush the coefficient of friction increases with the pressure, due to the lack of this lubrication. It will be noted from these curves that the coefficient of friction of the very soft brush is approximately seven times the coefficient of friction of the hard brush at two pounds per square inch pressure. At four pounds, the coefficient of friction of the soft brush is approximately three times that of the hard brush, but when we reach six pounds per square inch the coefficient of friction of the soft brush is only slightly above that of the hard brush.

The writer has carried on a number of experiments to show the effect of current density on brush pressure, but has not carried this work far enough to reduce any general laws. Most of these results showed that the coefficient of friction decreased when the current density increased and this is very pronounced in high-friction brushes. On one grade, which has a friction of 0.9 without current, the coefficient of friction became as low as 0.2 at a current density of 80 amperes per square inch and the intermediate results produced a smooth curve. This reduction in coefficient of friction was attributed to a graphitization of the brush face, due to a high surface temperature, produced by the minute arcs through which the current must travel from the commutator to the brush.

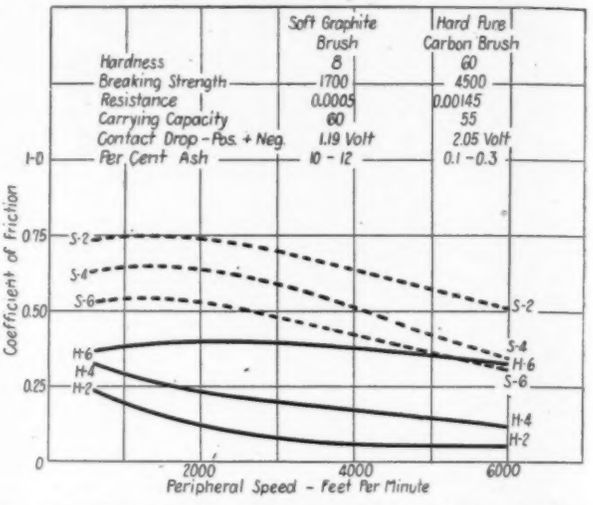


Fig. 2.—Coefficient-of-Friction Curves of a Very Soft and a Very Hard Brush.

Brush Contact and How It Is Affected by Pressure, Current Density, Etc.

Contact drop is the voltage drop between brushes and commutator when current is flowing. The drop when the direction of current is from brush to commutator is generally different from that when the direction is from commutator to brush. The results published by the brush manufacturers are usually the sum of the two.

Fig. 3 shows a machine used to determine this characteristic. It consists of a copper ring on which two brushes run. Current is passed in at one brush and out at the other. Clamps to which voltmeter leads are attached are fastened to each brush ⅛ inch from the face of the brush. An amalgam contact operates on a disk attached to the shaft. The voltage values read include the resistance of the ⅛-inch length of brush between the face and the clamp, but as the brush is 2¼ inches wide by ¼ inch thick, the brush resistance is only about 10 per cent of the resistance of an inch cube of the material. As contact resistance is approximately ten times the specific resistance of a brush at ordinary current densities, this error is reduced to about one per cent of the actual contact drop, which is much closer than values of contact drop can be duplicated.

Several years ago the writer made an exhaustive test of contact drop on 14 different grades of carbon brushes. Contrary to expectations, heat applied artificially to either the slipring or the brush had practically no effect on contact drop. This was tried up to temperatures of 250 degrees Fahrenheit, which is beyond normal operating conditions. In measuring contact drop, however, we are dealing with infinitesimally thick surfaces of which the temperature cannot be measured, and it is possible that, when current is passing, these surfaces are heated to such temperatures that contact drop is affected.

The machine on which the tests were conducted could be operated up to only 1,250 feet per minute surface speed without vibration. Contact drop was found to increase approximately eight per cent between 250 and 1,250 feet per minute. This is probably due to the suction of air under the brush face,

which lessens the intimacy of contact between the brush and the ring.

The composition of brushes has more effect than operating conditions on contact drop, except perhaps high mica or very low brush pressures. The average contact drop (positive plus negative) of the 14 grades tested was 1.38 volts. Individual contact drops varied from 0.86 volt in a low-resistance flake-graphite brush to 2.16 volts in a lamp-black brush.

Readings were taken at current densities ranging from 5 to 75 amperes per square inch. The average contact drop increased 31 per cent when the current density was increased from 5 to 30 amperes per square inch. A further increase of 13 per cent took place when the current density was increased to 60 amperes per square inch. This characteristic more than offsets the negative temperature-coefficient of resistance of carbon and tends to keep the current distribution uniform when the pressure is uniform.

From these tests, together with experience in actual practice, it is found that in most cases good operation cannot be secured without a pressure of at least 1½ pounds per square inch and as a safety-factor 2 pounds per square inch is recommended for stationary machines and 3 pounds per square inch for elevator and mill-type motors. The pressure on crane motors, railway motors and similar machines must be considerably higher, generally from 4 to 7 pounds, depending on service conditions. The most suitable pressure should be determined by test.

Contact drop plays a very important part in the operation of a machine, particularly where the coils undergoing commutation are in a field which varies with the load. Many cases of poor commutation have been cured by the use of a brush with higher contact drop.

At first glance it may not appear economical to use a brush with high contact drop, but where this characteristic will reduce short-circuit currents under the brush face, the reduction

Fig. 3.—Machine for Determining Contact Drop.

in heating, and the increase in efficiency is much greater than the additional loss occasioned by the higher contact drop.

An increase in brush pressure will increase the loss due to friction and decrease the loss due to contact drop. It is therefore advisable to use the lowest brush pressure that will always insure good contact between brush and commutator and will enable the brush to keep the commutator polished.

Among the Contractors.

The firm of Belfit & Thorky, electrical dealers, Suffield, Conn., has been dissolved, Thatcher Belfit having sold his interest to Mr. Thorky, who will continue the business.

Russell & Company, electrical contractors, 56 West Forty-fifth Street, New York City, have been awarded the contract for the electrical work in connection with the large office building for the New York Edison Company, to be erected on the northeast corner of 177th Street and Monterey Avenue, New York City. This building will be a six-story reinforced concrete office building, 50 by 103 feet, and the electrical equipment consists of 400 ceiling and wall outlets, 400 base receptacle outlets, 150 switch outlets, bell work, reflectors and closed-circuit fire-alarm system; also 109 public telephone outlets. The work throughout will be in galvanized steel conduit, and the panelboards and switchboards are to be made of Murray removable fuse cutouts, as manufactured by the Metropolitan Engineering Company, of New York City.

The Electric Supply Company, Memphis, Tenn., has been awarded the contract for supplying wire, cable and lighting units for the Mississippi Centennial at Gulfport, Miss., in competition with concerns in New Orleans, Atlanta, Birmingham and other cities. The contract is for $35,000 and calls for 150 torch lamps and 11 miles of cable. The General Electric Company is stated to be designing a special lamp posts for the torch lamps to be used on the exposition grounds.

A new company has started in the electrical business at Miami, Fla., under the name of the Electric Motor Exchange, and will deal in new and second-hand electrical machinery, fans, lamps and electric fixtures. The company desires to receive catalogs from electrical manufacturers.

Frank E. Werver, Newark, N. J., has organized an electrical supply business under his own name to operate from 74 Orange Street. Mariano Alonzo is also interested in the business.

The A. T. Vick Company, of Houston, Tex., with capital stock of $10,000, has been incorporated by A. T. Vick, P. S. Grogan and R. W. Franklin. The purpose is to deal in electrical and heating apparatus.

The Decker Electrical Construction Company, San Francisco, Cal., did the wiring and the Brumfield Electric Sign Company furnished the signs for the new Casino Theater just completed in San Francisco.

Conduit Construction Required in Los Angeles.

Mention was made in the last issue of the requirement of conduit or metal-molding construction in Los Angeles, Cal., beginning April 1. Further particulars are now available. The new ordinance is much more drastic than have been the provisions existing in the past. Conduit construction is required in all structures, without exception. The only instances in which armored cable will be allowed are where "it is impracticable to install rigid conduit or metal molding, and when written permission has first been secured from the Board of Public Works." Similar provisions heretofore applying to fireproof structures now apply also to the smallest buildings, where previously frame residences of less than six rooms have been given many concessions.

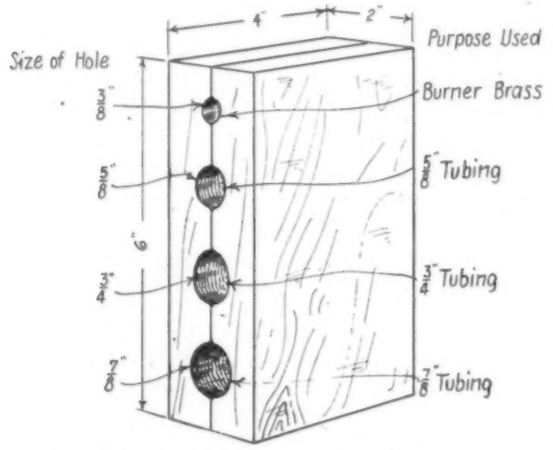
USEFUL WIRING HINTS

A collection of some short-cut or otherwise valuable suggestions which, though not entirely new, are not as well known by wiremen as they deserve to be. Most of these suggestions have been submitted for publication as "Dollar Wiring Kinks," which department is intended for new and original ideas only and will reappear soon.

Cutting Nonmetallic Flexible Conduit.—In cutting nonmetallic flexible conduit or tubing the knife used is likely to become gummy and almost useless for decent cutting. I find that by dipping the knife into water several times during such cutting, it will not get sticky to anything like the extent that it does when kept dry. If no water is at hand, a little spittle will do nearly as well. This method will save a great deal of time and trouble for the electrician.

H. T. St. Clair.

To Hold Fixture Casing in Vise.—The accompanying sketch shows a simple means for holding several sizes of fixture casing or tubing in the vise to allow cutting without damaging the tubing. A block of suitable size, say 6 by 2 by 4 inches, has three or four holes bored through it to correspond to the sizes of tubing commonly used. It is then sawed



Block for Holding Fixture Casing in Vise.

through the center and the ridges and their edges carefully smoothed. When it is desired to cut a piece of tubing, it is placed between the blocks in the hole corresponding to its size, and the whole clamped in the vise ready for cutting.

Edgar W. Weaver.

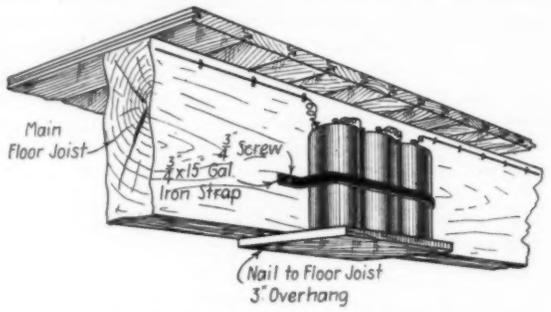
Lubricating the Snake for Difficult Conduit Fishing.—Many times in the case of a long conduit runs with numerous bends and elbows it is very difficult to push the fishing snake through when it is desired to fish the wire into place. Various lubricants, such as graphite or oil, are commonly applied to the point of the snake to lubricate it, but most of these are objectionable. Oil deteriorates the rubber insulation of the wires and graphite is a conductor and its presence in the conduit lowers the insulation. To overcome these disadvantages, I have found paraffin a good lubricant to use. It is good both as a lubricant and as an insulator and does not hurt rubber. The head end of the snake and a stretch of five to eight feet back of it should be well rubbed with a piece of paraffin and it will then slip in easily.

G. H. Stone.

Protection in Storage-Battery Work.—Whenever I have storage-battery work to do, I make sure of carrying some washing soda and a small bottle of strong ammonia water with me. To prevent the battery solution from causing sore hands, especially by its action on cuts or bruises, I dip my hands in a weak solution of washing soda and water; this counteracts the effects of the acid electrolyte. If my clothes get spattered with the solution I wet the spots with a piece of waste dipped in or soaked with the ammonia water; this will neutralize the acid and prevent it from leaving a stain or even burning a hole if it is applied in time.

M. J. Moriarty.

Neat and Simple Battery Support.—I have found that a simple battery support for small apartment buildings, residences, etc., can be made as shown in the sketch here-



A Neat and Simple Battery Support.

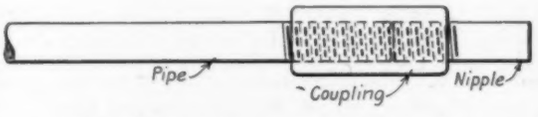
with. It has the advantages of being neat, compact and easily made, while at the same time it includes a guard to prevent the dry cells from falling off the supporting board due to vibration. This guard strap is made up of thin galvanized iron about three-fourths inch wide by about 15 inches long. To remove the cells for renewal it is necessary merely to loosen the screws of the strap.

M. J. Moriarty.

Installing Flush Switches Without Soiling the Wall.—The modern wireman prides himself on being able to wire an old house without dirt and mess. He frequently has to put in a flush switch on a delicately tinted or other light finished wall. This can be done without soiling the wall as follows. Cut a hole in a clean piece of cardboard about a foot square, the hole to be just a little larger than the switchbox and near the center of the cardboard. Mark on the wall the exact location of the switchbox and place the cardboard over it, tacking it to lightly by means of short thin brads. Now cut the plaster and install the box. This can be done with as much speed as on an ordinary wall, because the cardboard protects the wall from being soiled by finger or tool marks. When the cardboard is removed and the face plate put on, the wall will show no usual dirt or signs of recent work, resulting in a neater job, which is usually appreciated by the owner.

J. Burns.

Convenient Holder for Use in Threading Nipples.—It is often necessary to make conduit nipples on the job. In the accompanying sketch is shown a simple nipple holder that will be found handy for this purpose. It is made of a piece of pipe and coupling of the same size as is being used for making the nipples. The pipe is given a little longer thread than usual and then the coupling is



Pipe Holder for Use in Threading Nipples.

screwed on tightly. The pipe to be used for the nipples is threaded and cut off and the half-made nipple is then screwed into the coupling so as to butt the end of the holder pipe inside the coupling. In cutting the thread on the nipple it may be necessary, of course, to remove the bushing from the die stock, if the nipple is very short.

Arthur S. Nickerson.

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"LET THE CODE DECIDE."

Secretary's Message.

At the recent convention of the Association in New York City, one of the principal subjects for discussion was brought up in the form of the following three questions, and it was voted that a committee should be appointed to gather field experience from our members and others and report within a year to the Executive Committee.

Ex-president Day has been good enough to throw together some interesting material upon the subject, which is presented below. The committee will shortly be appointed by President Devereux, and the several sections and members-at-large will be circularized in regard to the matter.

I take this opportunity, however, to ask *each and every member* who reads this, and also other persons interested therein, to begin putting their field experience in order and also to be so good as to send to my address, without waiting for formal questionaires, etc., whatever information they have at hand so that it may be used in formulating matters upon which information as to further particulars may be asked.

The Western New England Section held its spring meeting in the Aldermanic Chamber of the City Hall at Holyoke, Mass., on Wednesday, April 11, when in addition to the usual routine of Section work a very interesting paper upon the problems presented in protection of telephone circuits was read by F. M. Hill, of New Haven, which paper is presented below. The next meeting of the Section will be held in Hartford in July, the subject for discussion then being the hazards of wireless telegraph apparatus and installations.

The British Columbia Section held its annual meeting recently, the old list of officers being unanimously re-elected. A report of this meeting will be given at a later date.

Removing Non-Metallic Protective Coatings at Junctions of Metallic Conduit, Molding, Fittings, Etc.

Rules No. 27, 28 and 29 provide when the armor of cables, conduit and metal molding, couplings, outlet boxes, junction boxes, cabinets, and fittings have protective coatings of non-conducting material, such as enamel, such coating must be thoroughly removed from the threads of couplings, conduits, armored cables and metal moldings, and from the surfaces of the boxes, cabinets and fittings where the armor of cables, conduits, and metal moldings, or ground clamp is secured, in order to obtain the requisite good connection.

How closely are these rules being enforced by our members in the above particulars?

If they are not enforced, have our members any good reason for not enforcing them?

Would it contribute to the real purpose of the rules to enforce them in the particulars mentioned?

The matter appearing in this section consists of questions on the National Electrical Code, its interpretation and meaning, and questions as to whether certain methods of wiring are in accord therewith. These questions are gladly received from anyone interested, even if not a member; they should be sent to the secretary with any needed elucidating sketch. They are answered by each member of the Executive Committee according to his knowledge of what the ruling would be in his jurisdiction.

It should be understood that no pretense is made to give an authoritative interpretation of the Code. This is a voluntary association; it has representation on the Electrical Committee of the National Fire Protection Association, which prepares the Code, but it has no right, and claims no right, to give a final interpretation of anything in the Code. It is only intended to give the interpretation which seems correct to the members of the Executive Committee. No attempt is made to edit or correlate the answers from the different members of the Committee, as it is felt that the occasional difference of opinion is calculated to lead to a further study of the matter in question, further discussion and the final clearing up of obscure points.

The aim is to help toward a better understanding of the Code on the part of all; a more uniform conception of its meaning; increased precision in applying it; and harmonious action of those using it, for the common good.

Former-President Day's Answers.

We have here three questions all bearing practically upon one subject, all of the questions seeking direct field experience and practice. It would seem reasonable for all of us to advance some form of answer, as it seems difficult to think that any of us are without field experience in the several forms of the question. We permit the use of armored cables, conduit and metal molding, do we not? Then, how do we permit them to be installed? The answers would, therefore, indicate our field experience.

Offering my own experience and practice, I frankly state, in answer to the first question, that I am not, and have not for a long period of time, urged the removal of the protective coatings of non-conductive material, such as enamel, from the fittings thus coated. I cannot even tell you when I have seen any one make an effort to remove the non-conductive coating. Thus, in a few words, I have answered the first question, but, in doing so, please do not think I have fallen into a rut dug alone by a general condition. I have conversed with a number of brother inspectors, also with a number of installing contractors, and the answer has been the same as mine, an utter lack of observing and enforcing the rules, in the particulars mentioned.

In relation to the second question, I feel that I have a reason for not enforcing the requirements for removing the non-conductive coating from the several types of metal installations, although I am not sure you will consider it as being a good reason. You are all familiar with my friendship and interest in the National Electrical Code. I have never felt that it required the services of any association of electrical inspectors to construct it, but that it did need the services of electrical inspectors in applying the spirit and intent of the Code. My reason for not enforcing the requirements mentioned will be found in that comprehensive expression, "spirit and intent of the Code."

I have known the Code almost from its inception and I have yet to learn of a single instance where the requirements have sought to increase the installation expense, when no hazard would be introduced or maintained. The

questions seem to discourage a continuance of non-conductive coatings on the material and fittings used in metal installations. That it is the very purpose I would like to see accomplished, for it was myself who framed the questions.

Let us first consider the economic side of the answer, as it may concern the installation expense. Some manufacturers of metal fittings have advised me that fittings having a protective coating of conductive material, such as galvanizing, would cost 10 per cent more than would fittings having a non-conductive coating. Some of our largest and most experienced contractors have told me that it would cost from 20 per cent to 30 per cent more to install fittings having a non-conductive coating, if the letter of the requirements were complied with, in relation to removing the non-conductive coating so that the requisite good connection might be obtained.

The requirements make reference to a "protective coating of non-conducting material, such as enamel." Let us consider a ceiling outlet, having a square box, from which 12 conduits, three on each side of the box, go to other outlets. That "the requisite good connection" may be obtained would practically mean that the greater part of the enamel would be removed from each of the four sides of the outlet box. This being a possibility, would the sides of the box be protected from the possible corrosion or rust? Would not the corrosion or rust, in time, destroy the much needed "good connection?" Under the conditions expressed, and they are not unusual, would not the real purpose of the protective coating be destroyed? It is true, the letter of the rules would have been observed, but what about the "spirit and intent" of the rules clear. What I have made the difference between the letter of the rules and the "spirit and intent" of the rules clear. What I have said in relation to the installation of an outlet box, would also apply to junction boxes and to cabinets, only in a much greater degree.

Let us consider the threads of conduit, threads made in the factory before the conduit is enameled. To remove this enamel would require a contracting of the die with which the threads are made, thus making the diameter of the conduit, at the factory-made threads, smaller and non-standard. The same would apply to the threads of a coupling, running the tap through the coupling would increase its internal diameter. In company with a number of inspectors in New York City recently, all agreed that they had never seen a thread tap in use where conduit was being installed. The smaller diameter of the conduit and the increased diameter of the coupling would not make a tight and a secure joint, thus departing from the "spirit and intent" of the rules.

In the third question we reach the pith of the problem. "Would it contribute to the real purpose of the rules to enforce them in the particulars mentioned?"

Here, again, I feel that we must be guided by the "spirit and intent" of the rules. In the Code of 1903 will be found the following fine-print note.

It is essential that the metal conduit systems be joined so as to afford electrical conductivity sufficient to allow the largest fuse or circuit-breaker in the circuit to operate befor a dangerous rise in temperature in the conduit system can occur. Conduits and gas pipes must be securely fastened in metal outlet boxes so as to secure a good electrical connection. Where boxes used for centers of distribution do not afford good electrical connection, the conduits must be joined around them by suitable bond wires. Where sections of metal conduit are installed without being fastened to the metal structure of buildings or gronded metal piping, they must be bonded together and joined to a permanent and efficient ground connection.

At this period of the Code's history fine-print notes were frequently applied as rules, and the foregoing fine-print note was no exception to the general practice. The purpose of bonding the conduits was to secure a good ground connection. The method suggested by the rule quoted was not a desirable one, inasmuch as the bonding of the steel conduits with No. 14 copper wire, and I have seen them bonded with No. 18 copper wire, produced an electrolytic action, at the expense of the copper bonding.

This method of bonding gradually fell into disuse, because of its unreliability in maintaining a "permanent and efficient ground." The present requirements came into use, as a suggestion only, in the form of a fine-print note, in the Code of 1911, and as a mandatory rule, in the Code of 1913. The purpose stated in both of these Codes, also in the Code of 1915, is identical, "to obtain the requisite good connection." This would seem to discourage any preventable high-resistance path to ground.

I have been greatly surprised at the result of tests I have made of the resistance at coupling in runs of conduit. The resistance increases with the age of the installation. The same is true of conduits at outlet boxes and cabinets having a non-conductive coating. These resistances are largely preventable by the use of protective coatings of conductive material and the resistance will not increase as do the fittings having coatings of non-conductive material.

We have a problem before us. I know this subject is receiving study by several interests. Some interests have expressed themselves to me as being in favor of discontinuing the use of all material, devices and fittings, used in metal installations, having a non-conductive coating. The supply houses and contractors would welcome a change, it being a step in the direction of standardization and doing away with the present-day practice of carrying duplicating stocks. A change would also give to an installation a much better path to earth than is now possible with the use of material and fittings having a non-conductive coating. We should not, however, lend our spport to any effort which would seek to permit of the installation of material and fittings which have no protective coating.

Some manufacturers of materials and fittings used in metal installations would welcome the change suggested by the questions. Most manufacturers could comply with the suggested change without any very great expense or change in their factories. To some, however, the changes would appear radical and could not be made without very great financial hardship to them. In this particular, I refer to the manufacturers of large metal cabinets, cabinets which are frequently abnormal in size and are never to be found in stock. I know of one such cabinet, to be installed in a theater in my teritory, its great size being beyond the size of any galvanizing bath now in use. But even this is a matter of detail and I believe it can be solved.

I have stated that I thought the office of the electrical inspector was to supply the "spirit and intent" of the Code and not to engage in the construction of the Code. To attempt to offer a suggestion as to how the detail of large-sized cabinets might be brought within the "spirit and intent" of the Code would appear as though I had changed my mind, in this particular. But I have not, it being my desire to explain and to answer the several questions asked and to leave the further problem to those who make the specifications of standards for such materials and fittings which are used in metal installations.

Protection of Telephone Equipment Within Buildings Against Lightning and High-Potential and Sneak Currents.

By F. M. Hill.

We have pretty well standardized the grounding of light and power installations and the method adopted seems to be satisfactory. But the grounding and protection of telephone stations present a different problem for many reasons.

Power and light installations are more simple for the reason that each installation is a tap off the same line or feeder which is generally exposed to the same conditions throughout its length. But the telephone subscriber (in the case of single-line service) has a line running direct

from the central office to his home and this line is exposed to varying physical conditions throughout its entire length, and as the units which compose this line vary it can be seen that each subscriber constitutes an individual problem.

Better to illustrate this subject and make it understandable, it may be well to take as illustration a typical line from central to subscriber. Such a line is called "a subscriber's loop." Starting from the battery, a storage battery of 24 volts for exchange service and 48 volts for toll lines, the wire runs through the various details of a multiple-jack operating board, which is very elaborate and unnecessary for our purposes to discuss, and thence to a main division frame where the pairs from their consecutive numbers are connected to the cables distributing to the subscribers. On this frame are mounted the "sneak-current arresters" or "heat coils," as they are called and the carbon protector blocks.

These heat coils are used to prevent excessive currents in the lines from injuring the delicate apparatus of the central office. By excessive currents we mean currents in excess of the battery and voice currents which may in this service amount to less than one ampere. This heat coil has a resistance of four ohms and is essentially a fine wire spring held in place by solder. A current of one-quarter ampere flowing for 15 seconds will melt this solder and thus ground the line or ring a bell as may be desired.

The carbon protector blocks are composed of two small blocks of carbon with a sheet of mica between, carefully calipered to a thickness of 0.005 inch. Imbedded in the carbon is a small plug of fusible metal designed to melt at a comparatively low temperature and weld the blocks together, thus grounding the line. Any voltage in excess of 750 is supposed to jump the gap.

Overhead Lines and Their Protection.

From this frame the wires are paired into the underground cables, which are buried under pavements and accessible only at manholes until the underground-cable terminal pole is reached. On this pole the aerial and underground cables are joined through a terminal box in which are mounted fuses usually of seven-ampere capacity. Here also, or at the next pole to it, the steel wire which carries the weight of the cable (or messenger wire as it is called) is bonded and grounded by running the wire down the pole to earth. Throughout the length of this cable at convenient intervals are tapped off terminals of the unprotected type which serve as taps in the cable for open-wire lines to care for subscribers along these points who are not more than half a mile from the cable. Reaching the end of the cable the wires terminate in what is called a "protected aerial-cable terminal."

Here we find a box in which are mounted copper protector blocks used on the main division and whose purpose is the same as a lightning arrester. The protectors are essentially the same as the carbon protectors just described, being made of copper, however, and not quite so sensitive. Their operation depends on the low resistance of the arc established between them. If the arc is prolonged for any appreciable time a portion of the metal blocks will melt and weld the two together, thus performing the same function as the carbon blocks. The reason for not making them quite so sensitive is because they are mounted on the pole and are designed to protect the insulated wire within the cable and are not for the purpose of protecting the subscriber or central office. If they were as sensitive as the carbon blocks, linemen would have to replace them after nearly every thunderstorm, which would constitute a nuisance. They are only meant to keep the potential between the pairs in the cable within their dielectric strength.

At this point also the open-wire lines are joined to the cable, the length of these wires varying any distance up to 10 miles. Reaching the pole at the subscriber's station, the twisted pair is tapped on and led into the house where are mounted immediately at the point of entry the fuses and protectors. These fuses are about four inches long of the cartridge type and generally of seven amperes capacity. Here also is mounted another carbon protector block to the ground wire, generally of No. 19 B. & S. led to the nearest water pipe. From this protector we finally reach the subscriber's set with its condenser and induction coil.

This method of grounding and protecting a line is standard with the Bell system and has proved most satisfactory for all cases and conditions on its lines.

Protection from Lightning and High-Tension Currents.

Now to take up the reasons for all these precautions, we find first that they are all installed to protect the line from foreign currents and voltages and not from anything likely to develop in the line itself or the equipment. Take first the effect of lightning. The actual discharge of a stroke onto a telephone is not really as hazardous as supposed. Lightning takes the shortest path to earth electrically, and it will at most break the wire and splinter a pole or two.

But the passage of a *charged cloud* over a line is the dangerous condition. According to the principles of induction, any charged body induces an equal and opposite static charge on adjacent insulated bodies. Inasmuch as a telephone line is an insulated body of considerable capacity, a charged cloud will build up a considerable static voltage on the line and this will distribute itself over a considerable distance. At the instant the cloud discharges in the form of a flash the telephone line will tend to do the same thing and thus will discharge itself at many points along the run, and perhaps at many stations. Further, the oscillatory character of the static discharge makes kick-backs, starts fires and causes many of our recorded "freaks" of lightning.

It is prohibitive to manufacture complicated arresters of oil type or choke-coil type and install so many of them, both for financial and practical reasons of installation. So we must depend upon this little carbon and mica protector, which is fused by the discharge into one solid ground, and upon blowing the fuses. Yet the small size of the ground wire is really insufficient to carry off lightning. But comparatively speaking, a No. 4 wire could not be much better when it comes to handling the enormous energy of such discharges.

Next, as to the exposure to foreign lighting and power circuits. As before stated telephone circuits cannot be as permanently and effectively grounded as these are; on the contrary they must be clear of grounds and perfectly balanced. Yet in order to protect them from foreign currents some means of grounding must be provided for them when they become charged. Again we depend upon the carbon or copper protector block. The Public Utilities Commission of Connecticut has ruled what class of construction is necessary on joint light, power and telephone lines. The heavier and stronger light and power wires must occupy the upper gains on the pole, the telephone lines being below with sufficient climbing space between the crossarms.

Joint line construction is not a desirable thing from the standpoint of perfect telephone service, either from a transmission or safety standpoint, but the demand for less poles on city streets by the public, and economy of construction make joint lines a necessity. The heat coil and protector are depended on in cases of crosses between the two systems and in almost every case they operate perfectly. The chief objection to joint lines is the inductive interference they produce, which impairs the transmission of the voice currents and cuts down the distance over which speech can be understood.

NEW APPLIANCES

A Review of the Latest Developments and Information Respecting Electrical and Kindred Mechanical Appliances

Radieye Attachment to Locate Switches in the Dark.

A luminous attachment, known as the Radieye, for pull-socket chains and flush-plate switches, has been developed to instantly locate these switches in a dark room by means of the luminous ray emitted from its radium composition. Since the luminant is a composition containing real radium and not phosphorus, the light is said to be permanent. No recharging is necessary. The radium is

Radieye Attachment at End of Socket Chain.

Radieye Attachment Above Switch Button.

protected by glass while the attachment itself has a brass body, which affords additional protection.

If used with a pull-chain attachment, the Radieye device is substituted for the usual ball at the end of the chain. When used with a flush-plate switch the Radieye device is substituted for one of the screws which attaches the plate to the wall.

This device is a recent contribution by the General Electric Company, Schenectady, N. Y., to the comfort and convenience of home lighting fixtures.

Inclosed Safety Switch for Outdoor Electrical Installations.

A new weatherproof safety switch has just been produced by the V. V. Fittings Company, Philadelphia, Pa., and is being marketed as type W. S. F. Simplicity in construction, operation and protection are all embodied in

Outdoor Inclosed Safety Switch.

the mechanism. The box is absolutely weatherproof. The switch operates with a straight pull, insuring a positive make and break, and can be locked in an open position to prevent tampering or accidental closing. The lid of the box has an adjustable support for holding it in an open position while making connections and fusing. There is also an attachment for adding lock and key. The switches are National Electrical Code standard and fused. They are built for 125 and 250 volts.

Automatic Cutout for Battery-Charging Panels.

The Hartman Electrical Manufacturing Company, Mansfield, O., manufactures a line of automatic cutouts intended for the protection of batteries used in connection with isolated-lighting-plant systems and also lighting, ignition and storage batteries while being charged in garages and service stations. The company has recently added to its line the type C cutout shown herewith. This cutout has a carrying capacity of 50 amperes and is adapted for either 32, 65 or 110 volts, which are the standard voltages used on isolated-lighting-plant systems.

The function of the automatic cutout is to connect the generator to the batteries when the generator is delivering a voltage high enough to charge the cells. It will also automatically cut out or disconnect the generator from the batteries when the voltage of the former is too low to charge the battery, or in other words, when there is a reversal of the current flow.

The type C cutout is made with two separate windings—a fine-wire or shunt coil, which is connected across the generator and which acts to close the circuit as soon as

Hartman Automatic Battery Cutout.

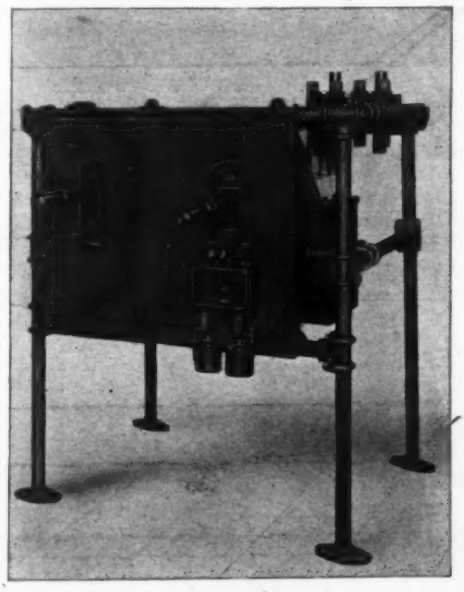
the generator voltage rises to a predetermined point, and a series coil which comes into action as soon as the charging circuit is closed and assists the shunt coil in holding the contact in the closed position. The moving contact is in the form of a cupped and slotted disk. It is directly connected to the solenoid core so that the full pull of the core is directly exerted on the contact. The contact is opened by gravity assisted by a weight, which construction prevents "freezing" or sticking and requires a minimum reverse current to open the switch. The small reverse current required to open the switch insures maximum life to the contact, as there is practically no arc drawn. The cutout is made for all classes of battery charging where a fixed generator voltage is used.

New Types of Westinghouse Autostarters.

The three types of autostarters herewith shown have been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., for use in connec-

tion with the operation of large squirrel-cage induction motors up to 650 horsepower. They serve to provide ample protection to motor, machinery, line and operator, by preventing excessive strain on the motor and disturbance to the line, reducing the line voltage and current in starting. Both motor and starter are protected against overloads and short-circuits. In special cases, where the power delivered to the motor is of high kilovolt-ampere capacity, the destruction of motor and starter is prevented by the provision of heavy circuit-breaking capacity. Resistance can also be furnished to prevent the opening of the circuit when changing from starting to running position, which frequently causes disturbances that may be injurious to both motor and starter.

These starters are extremely durable, and possess large, substantial contacts capable of breaking heavy currents frequently. The switching mechanism is simple and strong. The effect of arcing has been reduced to a minimum by the immersing of all contacts in oil and by the use of either auxiliary arcing tips or large contact areas on the main contacts. Where arcing occurs, the contacts are provided with removable tips which may be renewed readily with a pair of pliers. The starting current may

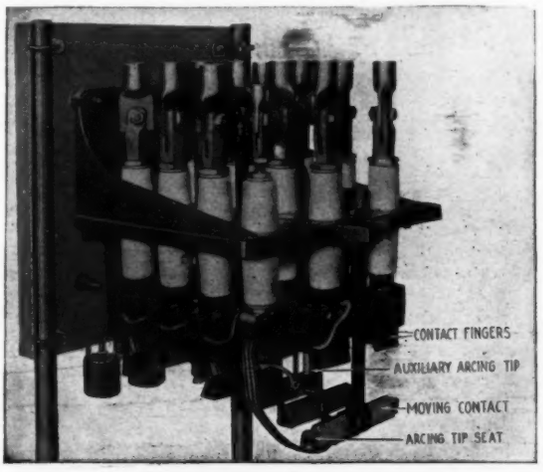


Front View of Autostarter Panel.

be adjusted to the service by taps on an autotransformer, which provides either three or eight starting voltages, according to the capacity of the transformer. Absolute safety to the operator is assured by excellent insulation in the switch and by a very liberal margin of safety above actual requirements. Safety to the apparatus is assured by overload relays, which cause the switch to open at a predetermined overload, and by a low-voltage relay which opens the switch when the voltage fails.

The three types of starters provide a range of capacities which will cover the majority of cases. The type Q starter is for use on two-phase and three-phase circuits of from 220 to 2,200 volts, 25 to 60 cycles. The types QF and QF-1 are for use with motors of larger capacity or higher voltage than can be started by the type Q starters. They differ from the latter mainly in their ability to handle larger currents and in having larger kilovolt-ampere breaking capacity, and in certain sizes also including a preventive resistance. They also have two handles—one for starting and the other for running.

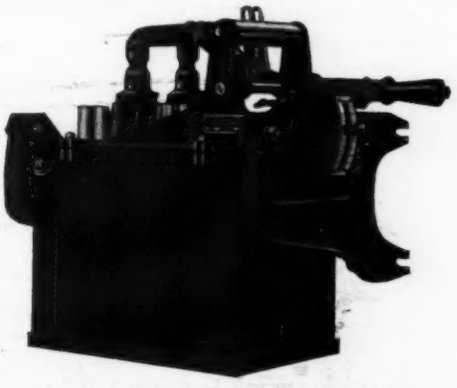
In starting a motor with the type Q autostarter, the switch handle is moved from the off to the full up or starting position and held there until the motor has ceased to gain speed. It is then moved downward as far as it will go, to the running position where it will remain. The handle will not remain in the starting position unless held, and it is impossible to move the handle directly from the off to the running position without first passing to the starting position. Where a type QF or QF-1 autostarter is employed having no preventive resistance, it is necessary to move the starting handle down as far as it will go and hold it there until the motor has ceased to gain



Rear View of Starter with Casing Removed.

speed. The handle is then released, and before it has fully returned to the off position the running handle is moved down as far as it will go, where it will remain latched. If a preventive resistance is used, the starting handle is held down until the motor no longer gains speed, then the running switch is closed and the starting switch released.

Overload and low-voltage protection is furnished for all types, protecting the motor from overloads and from the effects of failure of the supply voltage. The overload

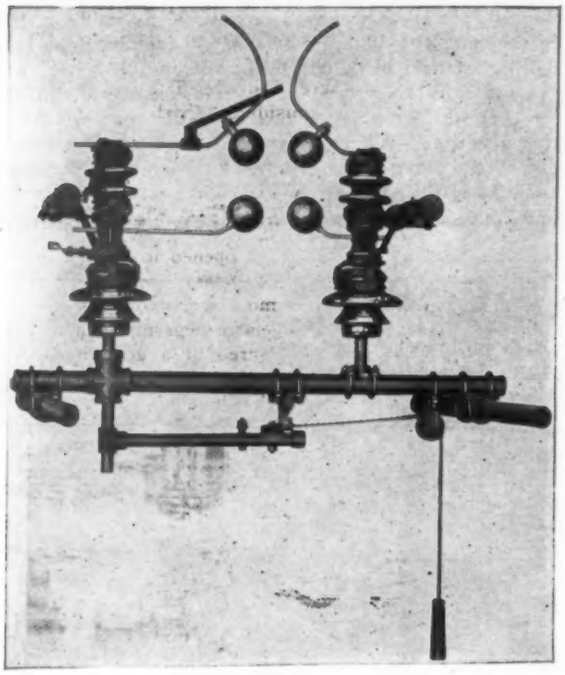


Large Self-Contained Autostarter Unit.

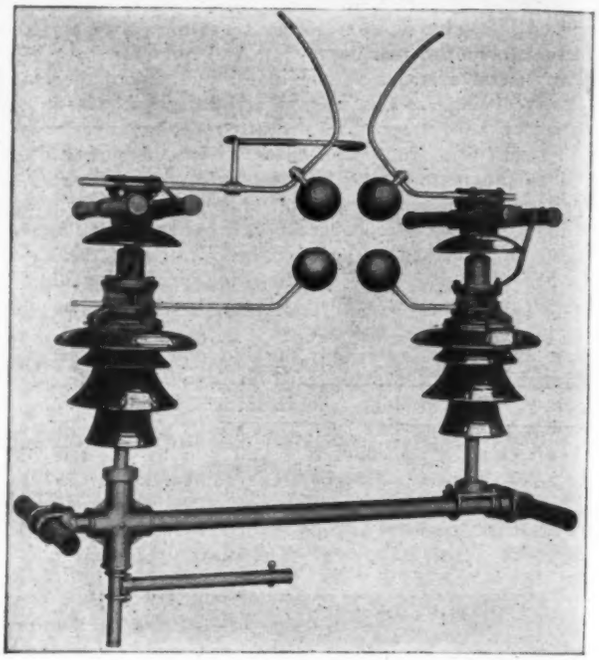
relay operates very slowly on slight overloads and almost instantaneously on short-circuits. Consequently the motor circuit is not opened for a momentary overload, such as during the moment of acceleration when the switch is changed from starting to running position. The low-voltage relay operates whether the voltage fails quickly or slowly, affording full protection.

Sphere Horn Gaps Found to Be Fastest for Electrolytic Arresters.

The latest development in aluminum type electrolytic-lightning-arrester design is the use of sphere gaps. All these arresters made by the General Electric Company, Schenectady,



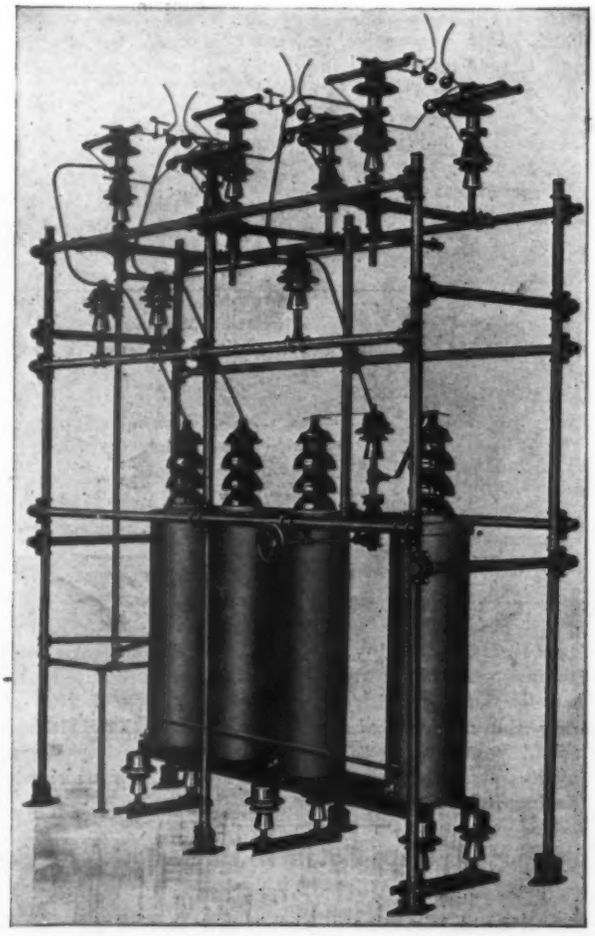
New Sphere Horn Gap for 25,000-Volt Single-Phase Aluminum Lightning Arrester.



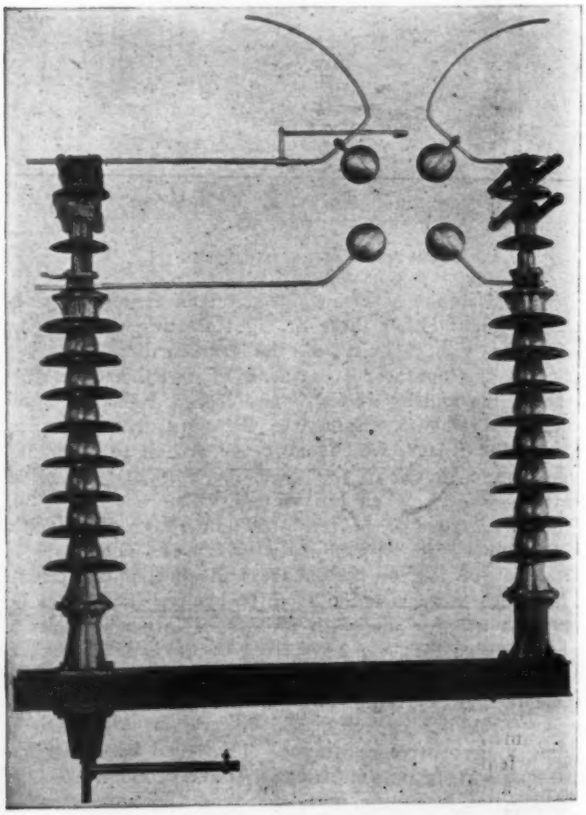
New Sphere Horn Gap for 70,000-Volt Aluminum Lightning Arrester—Single-Phase Unit.

N. Y., for service above 7,250 volts are equipped with sphere gaps. For lower capacities, the diameter of the copper rod used to make the horn gap is so large in proportion to the gap that the effect is the same. For all practical purposes, therefore, all G-E aluminum arresters may be considered as having the sphere gaps.

The upper spheres have horn extensions to assist the arc to rise and be extinguished quickly. Horns are not necessary



Three-Phase Aluminum-Cell Lightning-Arrester Installation with New Sphere Horn Gaps for 27,000 to 37,900 Volts.



Single-Phase Sphere Horn-Gap Section for Aluminum-Cell Lightning-Arrester Equipment Designed for 115,000 to 135,000 Volts.

on the lower spheres, as the arc rises from these to the upper ones and is thus extinguished.

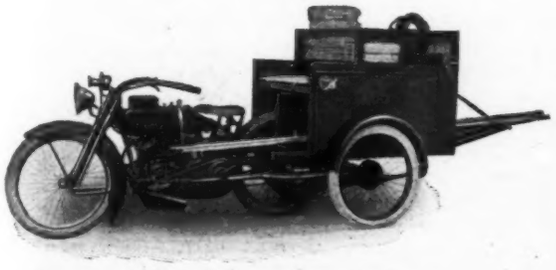
The sphere gap is faster for sudden impulses than the horn gap. It has a shorter dielectric spark lag. This is a necessary characteristic for protection against the sudden impulses of electrical disturbances. Protective gaps should be as "fast" as possible and the insulation of the other apparatus as "slow" as possible, because a definite time is required to flash over or rupture all insulations, such as air gaps, surface and solid dielectrics. The time interval varies with the nature of the insulation, the shape and spacing of the surfaces or electrodes and the frequency and magnitude of the applied voltage. Differences in the dielectric spark lag, although of infinitesimal time, are appreciable when the rate at which the abnormal voltages can be applied are of such extremely high frequency as is the case with lightning or similar disturbances.

Because of this phenomenon of dielectric spark lag, a voltage in the form of a sudden impulse may not break down what is apparently the easiest path. For example, the voltage may rise beyond the normal discharge voltage (60-cycle) of the protective gaps and arc over or puncture insulation having a much higher discharge test voltage.

The needle gap is the slowest kind of air gap. The horn gap is considerably faster, but the sphere gap is the fastest of all, in rate of discharge. It therefore follows that arresters with this means for rapid discharge furnish the most complete protection.

Motorcycle Service Cars for Contractors, Small Construction Gangs and Merchandise Deliveries.

Speedy and economical delivery of supplies from the electrical contractor's shop to jobs on which the workmen are engaged is an important means of cutting out waste of time and money. The same applies to deliveries for small construction gangs of electric light or telephone



Cygnet Motorcycle Service Car.

companies. The ordinary automobile light-delivery car can be used, of course, but its first cost and upkeep is too high for many smaller firms. The advantages of automobile delivery without these relatively high costs can be availed of in a new service car of the motorcycle trailer type now being marketed by the Cygnet Rear Car Company, 1200 Niagara Street, Buffalo, N. Y.

As shown in the illustration, this Cygnet car is built with doors opening both at the front and at the rear. For contractors and supply houses, this makes it possible to carry length of pipe and other material considerably exceeding the length of the body of the car with the simple device as shown on the side of the motorcycle. On the regular top of the car, the extension has wire sides and open top, which especially adapts this model for carrying coils of wire, bundles of rope and other material. The seat immediately back of the motorcycle driver is a noteworthy feature, as it easily accommodates two passengers, so that a journeyman electrician and helper can be taken to a repair job instantly.

This model of Cygnet car is built for attachment to any standard make of motorcycle and is also equipped with brake for use in hilly cities or where there is congested traffic. It can also be provided with a top to protect the motorcycle driver where desired. The manufacturers of Cygnet rear cars have considerable call for a body of this style and it is meeting with much favor wherever it has been put in service.

Gyrating Fans in Five and Ten-Cent Store.

The latest five and ten-cent store opened in the Pittsburgh district is that of the McCrory Company, on Penn Avenue, East Liberty. It differs from most stores of this kind in that it boasts of a meat and vegetable department, a ten-cent restaurant where one may be assured of a good meal at a reasonable price, a soda fountain, which is kept open at night,

Gyrating Fans Above Soda Fountain.

and a 25-cent bargain basement. Another striking feature, which is original for a store of this kind, is the addition of a rest room, which is most completely furnished. To assure patrons of the restaurant and soda fountain of still further comfort a number of Westinghouse gyrating ceiling fans have also been installed. The problem of ventilating the store, which was of particular importance, especially in the basement where the ceiling is low and where very little outdoor air could be admitted, has been admirably overcome by the use of these gyrating fans.

The fans used on the gyrators are of the well known Westinghouse 12-inch, "silent six" type, with drawn-metal frames. The mechanical drive employed is positive and does not vary with the air reaction. The mechanism does not slow down and cannot revolve at excessive speed. The result is a steady even flow of air, the direction of which is continuously gyrating about the central axis. Breeze at any angle desired, from horizontal to 30 degrees below, can be obtained by means of a positive wing-nut adjustment at the side of the gyrating body.

Gyrating Fans in Low-Price Restaurant.

ACTIVITIES IN THE TRADE

Domestic Electric Company, New York city, has acquired property at 50 Park Place for a new sales establishment.

Julius Andrae & Sons Company, Milwaukee, Wis., electrical jobber, has increased its capital stock from $100,000 to $500,000.

Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has increased its capital from $450,000 to $1,000,000 to provide for plant expansion.

Electric Service Supplies Company, Seventeenth and Cambria Streets, Philadelphia, Pa., has awarded a contract for the erection of a new three-story brick addition, 45 by 61 feet, to cost $60,000.

Financing Electric-Railway Systems.—Passage of a bill now pending before the Wisconsin legislature would make it possible for villages and towns of the state to aid in financing and building electric interurban roads.

National Lamp Works of General Electric Company, Cleveland, O., has issued bulletin 28, which deals with show-window lighting, presenting in a general way the essentials of good show-window lighting and emphasizing especially the possibilities of light, direction and color.

ReQua Electrical Supply Company, Incorporated, jobbers of electrical supplies, for two years located at 114 St. Paul Street, Rochester, N. Y., has moved to 95-97 St. Paul Street, near the new Chamber of Commerce Building in that city. The new location gives the company about 10,000 square feet of floor space, providing for larger stocks and improved equipment for handling material.

Robbins & Myers Company, Springfield, O., manufacturer of motors, generators and fans, has issued the first number of its new factory organ, the "R. & M. Breeze," which will be devoted to chronicling the news and activities in its factory and organization and to forwarding the spirit of good fellowship and co-operation among its employees. The first issue is bright and snappy, and is a credit to the company and to the editor, Ralph M. Busbey, formerly of Chicago, and lately engaged in newspaper and general publication work in Springfield and Columbus, O.

The Home Electric Light & Power Equipment Company, a newly organized Massachusetts corporation handling the product of the Domestic Engineering Company, Dayton, O., has opened a Delco-Light store at 53 Canal Street, Boston. On the first floor is exhibited a model Delco-Light plant, consisting of a 16-cell, 32-volt storage battery, a one-unit gas-engine generator and an assortment of water pumps, electric fans, washing machine, cream separator and churn, all connected with the power equipment.

American Chemical Society Discusses Increasing Cost of Gasoline.—The American Chemical Society, at its spring meeting in Kansas City, Mo., April 10 to 14, dwelt with great emphasis on the difficulty of increasing the supply of gasoline to take care of the rapid increase in the production of motor vehicles requiring gasoline for fuel. "The manufacturers of automobiles have in their enthusiasm stumbled over their own heels," said one of the leading members of the convention, summing up the proceedings and the discussions. "Here they have been turning out motor cars to use gasoline, in increasing numbers, and the public has responded. More and more gasoline cars—but no corresponding increase in the gasoline to run them." Dr. Walter F. Rittman, of Columbia University, showed that gasoline motor cars have increased eight fold; the production of gasoline has increased only four fold, and the production of petroleum has increased only 30 per cent, in seven years.

The Barber-Foster Engineering Company, 605 Swetland Building, Cleveland, O., has prepared a bulletin on its line of electrically driven monorail hoists. These are built in sizes from one-quarter to ten tons' capacity, of the inclosed type.

Wetmore-Savage Company, Boston, Mass., New England distributors of electrical supplies, has issued an attractive mailing folder emphasizing its ability to serve the trade. Selling plans are outlined for Neuco electric ranges, Apex cleaners, Simplex ironing machines and Eden washing machines.

Boustead Electric & Manufacturing Company, dealer and manufacturer of electrical machinery, switchboards, etc., has announced the removal of its offices and factory from 215 First Avenue North to new and larger quarters at 16-18 Hennepin Avenue, Minneapolis, Minn., where additional facilities provide for the rapidly increasing volume of business done by the concern.

Italian Representative for Electrical Manufacturers.—The export department of Pass & Seymour, Syracuse, N. Y., advises that Frank Payno, Messina, Sicily, Italy, would like to get into communication with American manufacturers of electrical apparatus and supplies who desire Italian representation. He gives as reference the firm of Edward Miller & Company, Meriden, Conn.

Poole Engineering & Machine Company, Baltimore, Md., has recently acquired, through consolidation, the exclusive manufacturing and selling rights of the "Turbo-Gear," formerly manufactured by the Turbo-Gear Company, Incorporated, of Baltimore. Through long and severe service tests, the "Turbo-Gear" has proved to be one of the most highly developed speed-transforming devices on the market, for use with high-speed electric motors, steam turbines and other prime movers or driving machines which require a different speed from that of the driven unit. Descriptive catalogs will gladly be sent upon application to the Poole company.

New York Utility Reduces Electric Rates.—The Public Service Commission has accepted an offer of the New York & Queens Electric Light & Power Company to reduce its maximum rate for electrical energy from twelve to nine cents, with certain provisions. The new rates take effect May 1. The company maintains a "dollar minimum." It is proposed to reduce the maximum from twelve cents to nine and to wipe out the dollar minimum, substituting a service charge of 60 cents a month. It is set forth in the commission's order that no consumer's bill shall be increased under the operation of the new rates.

Electric Drive for Two New Superdreadnaughts.—Contracts totaling approximately $2,000,000 have been placed recently with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., by the New York Shipbuilding Company for furnishing the necessary electrical equipments for the propulsion of the new superdreadnaughts *Colorado* and *Washington*. The equipments to be furnished are practically duplicates of that contracted for by the Navy Department for the U. S. S. *Tennessee* now building at the New York Navy Yard. The four propellers, as in the case of the *Tennessee*, instead of being mechanically connected to driving engines or turbines, are to be driven by individual motors. The energy for the motors will be furnished by two turbine generators. In addition to the main generating equipments and propelling motors, the contracts include auxiliaries for the main turbine generators and smaller auxiliary turbine generators for supplying light and power throughout the ships. Westinghouse electric motors will also be utilized for doing nearly all the work on board from raising the anchor to steering.

New York Section of American Electrochemical Society Elects Officers.—At a joint meeting at the Chemists' Club on April 13, of the American Electrochemical Society with the New York Sections of the Society of Chemical Industry and the American Chemical Society, the following officers were elected for the ensuing year by the New York Section of the American Electrochemical Society: Chairman, J. V. N. Dorr, president of the Dorr Company; vice-chairman, E. D. Kingsley, of the Niagara Alkali Company, and secretary-treasurer, J. Malcolm Muir, business manager of *Metallurgical and Chemical Engineering.*

The Missouri Valley Electric Company, 1417 Walnut Street, Kansas City, Mo., has incorporated for $50,000, and succeeds the Independence Electric Supply Company, of Independence, Mo., the reincorporation adding $30,000 to the capital. H. A. Esler, president and treasurer of the old company, has the same offices with the new, and L. E. Allen, secretary of the old, becomes vice-president of the new concern. The secretary is C. G. Bateman, of the Fostoria Incandescent Lamp Division. The company claims to be the first electrical jobbing house in Kansas City to sell at wholesale only.

McCausland Engineering Company, Pennsylvania Building, Philadelphia, Pa., recently organized to manufacture motors and similar equipment, will build a plant at Chester to consist of three main buildings, 75 by 317 feet, 60 by 82 feet, and 33 by 46 feet, respectively, including power plant and other operating structures.

Niagara Power Bill Introduced.—Representative Flood of Virginia has reintroduced the bill for controlling hydroelectric power above Niagara Falls, in the exact form in which it passed the House at the last session. Mr. Flood said he expected no consideration would be given to the measure at this session and that he had proposed it simply to hold it in readiness for action at a later time. The bill provides for the issuance of permits for the use of 20,000 feet-second above Niagara Falls, authorized under the treaty with Canada. It provides that the companies using the water shall construct plants that will use the greatest amount possible of electric power for the water employed. It includes a clause for recapture by the government of the use of the water, in accordance with the terms of the recapture clause in the general dam act passed by the House.

PERSONAL AND BIOGRAPHICAL

MR. JAMES J. COONEY has been appointed assistant manager of the new-business department of the Toledo (O.) Railways & Light Company to succeed MR. L. LEMEN, who has been promoted to the New York offices of the Henry L. Doherty & Company.

MR. L. B. HARRINGTON, of Richmond, Ky., has been elected vice-president of the Kentucky Utilities Company, of Louisville, controlling a total of thirty-six utility plants, and will have his headquarters at Louisville. Mr. Harrington succeeds MR. ERNEST VANARSDEL, who has become identified with the operating department of the Interstate Service Company, of Indianapolis, Ind.

MR. W. C. WOODLAND, for eight years chief engineer of the Packard Electric Company, of Warren, O., has accepted a position as consulting engineer with the Steere Engineering Company, of Detroit, Mich., the change to become effective May 1. He will have charge of the latter company's electrical department as well as work in connection with its extensive gas engineering business. The company is the owner of a patented process for gas purification using electrical energy at high voltage, and Mr. Woodland has for some years designed the electrical equipment used in this process.

MR. HENRY F. HOLLAND, who has been manager of the electric range department of the Great Western Power Company, San Francisco, Cal., has severed his relations with that company, following the abandonment of plans for a comprehensive electric range campaign. Mr. Holland has returned to Los Angeles, where he is located at 1928 Highland Avenue, Hollywood. He has not announced his plans for the future, which are not definitely decided. Mr. Holland has been identified with the electric heating field for some years, and prior to joining the Western Power Company's organization was Pacific Coast representative of the Simplex Electric Heating Company.

MR. A. H. SWEETNAM, who has been connected with the engineering department of the Commonwealth Edison Company, Chicago, Ill., has resigned to accept a position with the Stone & Webster Engineering Corporation and will enter its engineering department in the Boston offices. Mr. Sweetnam was born in 1880 in Ligonier, Ind., where he received his early education. During the Spanish-American war he enlisted in the

A. H. Sweetnam.

157th Indiana Infantry, serving throughout the war. After being mustered out he was connected with construction departments of the Commonwealth Edison Company and the Detroit Electrical Company, leaving the latter company to enter Purdue University, from which he was graduated from the course in electrical engineering in 1905. During the following two and one-half years he was a designing engineer with Sargent & Lundy, Chicago, resigning in 1908 to become electrical engineer for the Cosmopolitan Electric Company, Chicago, which position he held until 1913, when the company was taken over by the Commonwealth Edison Company. At that time Mr. Sweetnam entered the engineering department of the latter company, and during the last four years has done very creditable work in the supervision of installation and repairs of Commonwealth Edison substations. His fellow employees in the engineering department tendered him a farewell banquet a short time ago, at which they gave expression of the esteem held for him by his Chicago friends, who wish him success in his new position.

MR. E. J. BILLINGS, formerly superintendent of power of the St. Joseph (Mo.) Railway, Light, Heat & Power Company, operated by H. L. Doherty & Company, New York City, has been made a general efficiency engineer for the Doherty organization.

MR. N. P. ZECH, formerly with H. M. Byllesby & Company, has become identified with the A. E. Fitkin & Company interests, and at the last meeting of the board of directors of the Interstate Electric Corporation, Commonwealth Light & Power Company and General Engineering & Management Corporation was appointed a director and vice-president.

MR. F. A. VAUGHN, of the firm of Vaughn & Meyer, consulting engineers, Milwaukee, Wis., has announced his acceptance of an appointment as consulting engineer of the new municipal street-lighting system for Milwaukee. In 1914 Mr. Vaughn was appointed engineer of lighting survey, and when the survey was completed last year received a temporary appointment as illuminating engineer. His recent appointment means that he will have charge of the engineering work in connection with the installation of the new street-lighting system. Mr. Vaughn is well known in the electrical and illuminating field, for his activities in numerous engineering societies as well as his consulting work. He has been a vice-president of the Illuminating Engineering Society and chairman of the Chicago Section of the same organization. He has also been very prominent in Jovian and other electrical circles.

CURRENT ELECTRICAL NEWS

Weekly Record of Construction Activities

EASTERN STATES.

CORNISH, ME.—It has been announced that the Western Maine Power Company is extending its lines to supply power to operate a portable saw mill owned by the Dupont Powder Company. The lot on which this mill will operate is one of the largest in western Maine, being estimated at 12,000,000 feet. The former company recently took over the property of the Hiram Light & Power Company.

CLAREMONT, N. H.—Nearly all of the right of way has been obtained for the Claremont Power Company's new 44,000-volt transmission line from Claremont to Charlestown, N. H., and construction will be started as soon as the ground is in suitable condition. This line will connect the Claremont Power Company with the Connecticut River System, and is made necessary by the large increase in the demand for current in the Claremont territory.

BRATTLEBORO, VT.—The Twin State Gas & Electric Company, through Vice-President H. L. Olds, has submitted plans to the City Commissioners for the installation of an ornamental lighting system to consist of 40 single-lamp standards.

NEWPORT, VT.—The Newport Electric Lighting Company is to erect a hydro-electric plant in Clyde River to develop about 1,000 horsepower. The estimated cost is $41,000.

ADAMS, MASS.—The Adams Gas Light Company, serving this community also with electricity, has contracted with the Adams Woolen Mills for the operation of its weave and card rooms by central-station service. The company will build about 2.5 miles of transmission line, in part on private right of way.

LITTLETON, MASS.—A. M. Kittredge, of Fitchburg, has been awarded the contract for extensions to the local lighting system.

NORTHAMPTON, MASS.—The Northampton Electric Lighting Company has closed its steam plant, at least for a time, and is taking energy from the Turners Falls Power & Electric Company, which operates a large hydroelectric station on the Connecticut River. Three 750-kilovolt-ampere 13,200/2,200-volt transformers have been connected in on the local central-station distributing system.

SPENCER, MASS.—The local central station, the Spencer Gas Company, is conducting an electric sign campaign.

HARTFORD, CONN.—A bill to increase the capital stock of the Seymour Electric Light Company from $30,000 to $250,000 has passed the Connecticut House of Representatives.

CUMBERLAND, R. I.—The Blackstone Valley Gas & Electric Company is erecting a transmission line from Woonsocket to Plainville, Mass., and arrangements are being made to tap this line to furnish service for the local Diamond Hill section.

PROVIDENCE, R. I.—A bill now before the Rhode Island Legislature to grant unrestricted right of eminent domain to the Rhode Island Power Transmission Company is being opposed by various municipalities, which ask exemption from the provisions of the act, claiming it gives too broad powers to the corporation. The measure has already passed the Senate.

ALBANY, N. Y.—The Panama Power & Light Corporation has filed notice of increase in its capital from $1,050,000 to $2,500,000, for expansion.

EAST AURORA, N. Y.—A reorganization of the East Aurora Electric Light Company has been effected by which Henry Ford, of McCarthy Brothers & Ford, Buffalo, assumes control of a majority of the company's stock and becomes its general manager.

NEW YORK, N. Y.—The Cities Service Company, operated by Henry L. Doherty & Company, 60 Wall Street, has increased its capital from $100,000,000 to $150,000,000, for improvements and expansion in its properties.

NEW YORK, N. Y.—The New York Central Railroad has filed plans for the installation of a new steam and heating plant, 45x225 feet, beneath the street surface at Forty-second Street and Lexington Avenue, to cost $175,000.

NEW YORK, N. Y.—The Hudson Power Corporation has been incorporated with a capital of $300,000,000, by Irvin D. Day, S. P. Curtis and T. R. Beal, to manufacture and supply electricity for light, heat and power, and to operate in Rennsselaer, Columbia, Dutchess, Putnam, Ulster and Greene counties.

NUNDA, N. Y.—The Nunda Electric Light Company, Inc., has increased its capital to $24,000 for expansion.

ST. GEORGE, STATEN ISLAND, N. Y.—The War Department has granted the Richmond Light & Railroad Company permission to install submarine cables in the Fresh Kills Creek from Rossville to Linoleumville.

SYRACUSE, N. Y.—Improvements and extensions to its local system, which will cost in the neighborhood of $500,000, are being contemplated by the New York State Railways Company.

UTICA, N. Y.—The contract for the erection of a $700,000 hydroelectric plant for the Utica Gas & Electric Company has been awarded to the Structural Concrete Company, Dayton, O. The Platt Iron Works received the contract for furnishing two water-wheels and other electrical apparatus.

NEW BRUNSWICK, N. J.—The Public Service Electric Company will build a new engine and compressor plant. Contract for the building has been awarded.

PATERSON, N. J.—The Board of Education, City Hall, will receive bids, 4 p. m., May 14, for electrical work, heating and ventilating in the new public school to be erected on Broadway. William J. Bentley is president of the Board.

PATERSON, N. J.—The Board of Public Works has authorized a contract with the Public Service Electric Company for the installation of a new street-lighting system on Main Street. The improvement is estimated to cost about $5,000.

PENNSGROVE, N. J.—The City Council has ordered investigations and estimates of cost for the installation of a fire alarm system.

WEEHAWKEN, N. J.—North Bergen Township Committee is considering application of the New York Telephone Company for permission to install aerial and underground conduit lines in about twenty streets in the township. P. A. Brady, Township Clerk.

ELIZABETH, N. J.—The City Council is arranging an appropriation for engineering work, surveys and preliminary plans for proposed municipal electric-lighting plant.

NEWARK, N. J.—The McGann Warehouse Company is planning for the installation of electric charging equipment for battery service in the new garage recently acquired at 27-35 Lombardy Place.

NEWARK, N. J.—The Board of Education will receive bids at 4:30 p. m., April 26, for electric equipment for county vocational schools as follows: Meter and instruments, motor generator set, slate switchboard and storage battery; also for small tools and supplies for electrical shop, as well as machine and carpenter shops. Specifications at the office of the Board, 31 Clinton Street. Wesley A. O'Leary, Director.

HARRISBURG, PA.—In connection with the surveys of the system of the Harrisburg Railways Company, now being made by Bion J. Arnold, Chicago, extensions and improvements in the power plants of the company are being considered.

LEMOYNE, PA.—Improvements at the United Electric Company's plant here, involving $125,000, are being planned by company officials. A new turbine, rotary converter and transformer equipment, will be installed. It will be necessary to construct an addition to the plant. Most of the equipment has already been purchased.

PHILADELPHIA, PA.—The Philadelphia Electric Company is taking bids for the erection of a new one-story substation, 135x145 feet, on Hunting Park Avenue.

PHILADELPHIA, PA.—The United States Navy Department has taken bids for the erection of a new four-story electrical shop at the League Island Navy Yard, about 130x325 feet. The plant is estimated to cost about $600,000.

QUAKERTOWN, PA.—Voters here will consider a proposal to reconstruct the municipal lighting plant at a cost of about $45,000.

READING, PA.—The Metropolitan Electric Company will increase the capacity of its generating plant in West Reading from 30,000 to 62,000 horsepower by the installation of a new turbo-generator and auxiliary equipment. The extension is estimated to cost $500,000. W. S. Barstow & Company, 50 Pine Street, New York City, operates this company.

WASHINGTON, PA.—A five-year contract for street lighting has been awarded to the Washington Electric Light Company, which will install new lighting units.

NEWARK, DEL.—The Town Council has awarded the contract for furnishing electric service to the town to the Wilmington & Philadelphia Traction Company.

ASHEVILLE, N. C.—The Asheville Telephone & Telegraph Company will improve its telephone system and replace poles within the fire limits on Charlotte and Woodfin Streets and in other districts with conduits. The cost of the improvements will be about $70,000.

BELHAVEN, N. C.—Bids are being received for labor and material for constructing light and water systems here. The specifications include one 250-horsepower motor-driven centrifugal pump and two 200-horsepower vertical centrifugal sewage pumps and motors.

NORTH CENTRAL STATES.

ALLIANCE, O.—The Alliance Gas & Power Company will increase its capital from $550,000 to $1,550,000. The proceeds will be used for the improvement of the company's plant and lines. W. J. Rose is general manager of the company.

DELPHOS, O.—Engineer W. P. Hurd, of the Northwestern Ohio Light & Power Company, Van Wert, O., has completed plans for a substation and power house two stories high, 20 by 64 feet, to be erected here, the cost of which will be about $20,000.

GENEVA, O.—Chester Hill, superintendent of the United Light & Power Company, has prepared plans for placing the distribution system underground in the business district and installing an ornamental lighting system.

GREENFIELD, O.—The Southern Ohio Power Company has been incorporated by L. J. Cole, W. A. Gray and others, with a capital of $10,000, to provide electric service in this vicinity.

MADISONVILLE, O.—The Cincinnati, Milford & Loveland Traction Company plans to extend its electric-railway line from Woodland Park to Hillsboro.

ST. BERNARD, O.—Bonds in the sum of $90,000 to provide for improvements for extensions and improvements to the electric-lighting and waterworks system are being offered for sale.

STEUBENVILLE, O.—The Beulah Coal Company has been formed by a syndicate headed by B. A. McFadden, of Wheeling, W. Va., and has purchased 1,000 acres of land in Warren township for $200,000. Electric shovels will be installed to mine the coal.

BRAZIL, IND.—The Crawford-McCrimmon Company, of this city, is making arrangements for doubling its power-plant

facilities, a new plant to be installed in the very near future.

DIXON, ILL.—Contracts have been signed for the erection of the new $70,000 steam power plant in Dixon by the Illinois Northern Utilities Company, the Adams Construction Company, of Chicago, being the successful bidder for the substructure and the superstructure, with a bid of $45,000, and the Lakeside Bridge & Iron Company, of Milwaukee, getting the structural steel work with a bid of $23,000.

LENA, ILL.—The Lena Electric Light & Power Company will increase its capital stock from $20,000 to $100,000. Some plant improvements are contemplated. G. W. Benfer is president of the company.

MOUNT VERNON, ILL.—Cities Service Company has sold the property of the Citizens' Gas, Electric & Heating Company, of Mount Vernon, to the Southern Illinois Light & Power Company, which is controlled by the Frey Syndicate, of St. Louis. The property was sold because of its isolation from other Cities Service properties.

GRAND RAPIDS, MICH.—City Engineer Schriver has submitted a proposal to put $75,000 in the budget this year to place all city wires underground.

LOWELL, MICH.—Bids will be opened this week for the construction of a hydroelectric plant here.

NORTH MUSKEGON, MICH.—A franchise has been granted to the Consumers Power Company to furnish electric service. A distribution system will be erected this summer.

EMBARRASS, WIS.—Plans are being made for the erection of a new hydroelectric plant here.

GREEN BAY, WIS.—A certificate of convenience and necessity has been granted by the Railway Commission to the Green Bay & Eastern Railway Company to build an interurban line from Green Bay through Manitowoc to Sheboygan.

HUDSON, WIS.—Citizens here have subscribed $1,735 for the installation of a white-way system in the business district. D. F. O'Connell is interested in the plans.

KNAPP, WIS.—The Wisconsin-Minnesota Light & Power Company, of Eau Claire, contemplates extending its transmission lines into Knapp.

LA CROSSE, WIS.—The Wisconsin-Minnesota Light & Power Company is making plans for the erection of a high-tension transmission line from the Wissota hydroelectric plant above Chippewa Falls to La Crosse. The line will be built from Wabasha to Winona on the Minnesota side and from Winona to La Crosse will follow the Burlington right of way.

OSCEOLA, WIS.—The Power Engineering Company, Corn Exchange, Minneapolis, Minn., has completed plans for a hydroelectric power plant at Osceola for the Osceola Mill & Elevator Company, of which C. C. Ladd is secretary.

SAUK PRAIRIE, WIS.—Farmers in this vicinity are planning to incorporate the Sauk Prairie Light & Power Company, for the purpose of erecting distributing lines to provide electric service for their farms. They propose to purchase energy from the Wisconsin Power & Light Company, which is erecting a transmission line to Baraboo.

WONEWOC, WIS.—The Power Engineering Company, Minneapolis, Minn., is making plans for a 50-foot dam with sluice gates. The power house will be constructed of concrete, steel and brick, and an auxiliary plant with gas-engine-driven unit will be installed. A. B. Gale is interested in the project.

BLOOMING PRAIRIE, MINN.—The L. G. Campbell Manufacturing Company, of this city, contemplates installing an additional engine and generator. George Upcraft is superintendent.

FARWELL, MINN.—A franchise has been granted to the Glenwood Electric Light, Heat & Power Company for installing an electric light and power plant here.

LANCASTER, MINN.—An election will be held to vote on a bond issue of $8,000 for an electric-lighting system here.

LITTLE FALLS, MINN.—The Little Falls Water Power Co. will build a transmission line to Darling, Minn., which may be extended later to Randall.

ELKADER, IOWA.—A franchise has been granted to Schmidt Brothers & Company for installing electric transmission lines in Clayton and Delaware Counties for 25 years. The company contemplates extending lines to Boardman, Cox Creek, Valga and Mallory townships, and to the towns of Littleport, Garber, Elkport and Collesburg.

TINGLEY, IOWA.—The Mount Ayr (Iowa) Light & Power Company has made a proposition to the Council for furnishing electric service here.

DATES AHEAD.

Southwestern Electrical and Gas Association. Annual convention, Dallas, Tex., April 26-28. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Texas.

American Electrochemical Society. Spring meeting, Hotel Statler, Detroit, Mich., May 2-5. Secretary, J. W. Richards, Lehigh University, South Bethlehem, Pa.

National Fire Protection Association. Annual meeting, Washington, D. C., May 8-10. Secretary-treasurer, Franklin H. Wentworth, 87 Milk Street, Boston, Mass.

Arkansas Association of Public Utility Operators. Annual convention, Pine Bluff, May 16-18. Secretary-treasurer, R. B. Fowles, Pine Bluff Company, Pine Bluff, Ark.

Missouri Association of Public Utilities. Annual meeting, aboard Steamer *Quincy* enroute from St. Louis, May 17-19. Secretary, F. D. Beardslee, 315 North Twelfth Street, St. Louis, Mo.

Electrical Supply Jobbers' Associations. Semi-annual meeting, Homestead Hotel, Hot Springs, Va., May 23-24. Secretary, Franklin Overbagh, 411 South Clinton Street, Chicago, Ill.

Iowa Section, National Electric Light Association. Annual convention, Des Moines, Iowa, May 24-25. Secretary L. E. Caldwell, Iowa City, Iowa.

National Electric Light Association. Annual convention, Atlantic City, N. J., May 29-June 1. Secretary, T. C. Martin, 29 West Thirty-ninth Street, New York City.

Electric Power Club. Spring meeting, Homestead Hotel, Hot Springs, Va., June 11-14. Secretary, C. H. Roth, 1410 West Adams Street, Chicago, Ill.

American Institute of Electrical Engineers. Annaul meeting, Hot Springs, Va., June 26-29. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York City.

HARRISONVILLE, MO.—A transmission line is to be constructed by L. R. Green & Son, of Pleasant Hill, to this place. W. B. Rollins & Company, Railway Exchange Building, Kansas City, are the engineers.

KANSAS CITY, MO.—George E. Kimball is chairman of a committee urging the City Council to establish a $1,000,000 municipal electric-lighting plant.

KIRKSVILLE, MO.—An election will be held May 4 to vote on the issuance of bonds in the sum of $118,000, to construct electric-lighting and water-works systems.

ST. LOUIS, MO.—J. H. Shirley, 4139 Manhattan Avenue, is interested in a plan to build an electric railway from Chicago to St. Louis, through Decatur, Clinton, Farmers City, Bellflower, Saybrook and Anchor City. The company will be organized with a capital of $50,000.

AGRA, KANS.—Citizens here voted in favor of issuing $8,000 in bonds for an electric-lighting plant.

BAXTER SPRINGS, KANS.—The Empire District Electric Company has been granted a franchise to furnish electric service here.

BISON, KANS.—The proposal to issue $9,000 in bonds, to furnish funds for building a transmission line to La Crosse, to receive electric service here was defeated at a recent election. It is thought another election will be held.

CANEY, KANS.—The power plant of the Caney Electric Light & Railway Company was damaged by fire, causing a loss of about $25,000. The plant will be rebuilt.

ELLIS, KANS.—A bond issue to provide for enlargement of the municipal power plant has been approved.

IRVING, KANS.—A proposition to issue bonds in the sum of $7,000, for the purpose of building a transmission line to Blue Rapids, Kans., and distribution and lighting systems in the city limits, has been approved by voters here.

TOPEKA, KANS.—A white-way system will be installed in Topeka Avenue from First Street to the fairgrounds.

WICHITA, KANS.—Property owners in North Water Street have petitioned for a white-way system.

HARVARD, NEB.—The Harvard Electric Company, of which A. W. Person is manager, is contemplating the installation of additional generating equipment.

LOOMIS, NEB.—Bonds in the sum of $3,600 for the establishment of an electric-lighting system have been approved. Energy will be secured from the plant at Holdredge, Neb.

WESSINGTON SPRINGS, S. D.—The local electric-lighting plant was destroyed by fire last week.

TURTLE LAKE, N. D.—The village has granted an electric light franchise to the Central Power Company, and it is expected that service will be furnished by October. The power plant will be located at the John Satterlund mine, and will furnish power for Washburn, Turtle Lake, Mercer, McClusky, Denhoff and Goodrich. The company is capitalized at $150,000.

SOUTH CENTRAL STATES.

HICKMAN, KY.—The Kentucky Utilities Company has purchased the local light and power plant.

SEBREE, KY.—J. J. Korb and associates, who are establishing an electric light and ice plant here, will erect a two-story building, 36x86 feet.

ALEXANDRIA, TENN.—A transmission line will be built from the electric plant at Watertown to furnish service here.

MARYVILLE, TENN.—The right of way for the construction of a transmission line for the Aluminum Company of America from Alcoa to Maryville, has been secured. The line will convey power from the hydroelectric plant at Alcoa to the aluminum plant at Maryville. Estimated cost of right of way, transmission lines and equipment is placed at $3,000,000.

NEW ORLEANS, LA.—According to City Electrician Olroyd the new ornamental lighting system in the principal business streets will be completely installed within the next two months. The work of laying conduits and bases for the standard is progressing rapidly.

NORMAN, OKLA.—A franchise has been granted to the Oklahoma Gas & Electric Company for the building of a high-tension transmission line, to run from Oklahoma City to Norman. The line is to be completed by June 1. The city of Norman is to be supplied with power from the central station at Oklahoma City, but the company will keep the local plant for emergency use.

BROWNFIELD, TEX.—Eugene Wood & Company are in the market for electric-lighting equipment for a small town. They wish to buy a moderately priced outfit, simple in construction and operation, that will not call for a high-priced operator, and that will permit of additional units being installed.

HAMLIN, TEX.—The Hamlin Light, Power & Ice Company, which has been incorporated here with a capital stock of $60,000, will build an electric light and power plant and an ice factory. The stockholders are: A. V. Wainwright, R. F. Price and F. A. Matthes.

KINGSVILLE, TEX.—The St. Louis, Brownsville & Mexico Railroad will install an electric light and power plant here for supplying its shops and terminals.

WESTERN STATES.

EUREKA, MONT.—The City Council has passed an ordinance calling for a special election to consider the matter of granting an electric light and power franchise to J. J. Tetrault and others, who propose to build a plant costing about $60,000.

LOVELAND, COLO.—Bonds in the sum of $83,000 have been voted for the establishment of a municipal electric lighting plant.

CLOVIS, N. M.—Bids have been called for by the Board of Trustees for additional equipment for the lighting system, including one 240-kilowatt generator, three 40-horsepower motors, one 20-horsepower motor, switchboard, instruments, etc.

PALOUSE, WASH.—The Washington Water Power Company will rebuild its power plant here under terms of a 25-year franchise passed by the City Council.

TACOMA, WASH.—A substation will be built here by the Chicago, Milwaukee & St. Paul Railway, to furnish power for the operation of its railway lines west of the Cascades. Power for the main-line operations will be furnished by the Puget Sound Traction, Light & Power Company, and will be generated at the Snoqualmie Falls plant. Plants will be built by the railroad company at Tacoma, Taunton, Doris, Kittitas, Cle Elum and Hyak, and will cost in all about $175,000.

TOUCHET, WASH.—The Pacific Power & Light Company, of Walla Walla, is building a substation in this city, and will supply electricity here from the Priest Rapids plant.

WAPATE, WASH.—The City Council has passed an ordinance granting the Pacific Power & Light Company a 50-year franchise to furnish light and power in Wapate.

KLAMATH FALLS, ORE.—The Reno Power Company has been granted permission by the City Trustees to enter the city in competition with the California Oregon Power Company in supplying electrical energy for light and power.

ALHAMBRA, CAL.—The Pacific Electric Railway Company will erect a substation here.

FOLSOM, CAL.—The Pacific Gas & Electric Company has completed plans for the reconstruction of its entire system in this place. The work will be started in the near future.

FRESNO, CAL.—The Darwin Development Company has begun the construction of an electric railway 23 miles long along the south shore of Owens Lake, to connect with the Southern Pacific steam line at Olancha.

LOS ANGELES, CAL.—Residents here have applied to the Board of Supervisors for the establishment of a highway lighting district, to be known as the Jefferson Lighting District of Los Angeles County.

LIVERMORE, CAL.—The Pacific Gas & Electric Company is building an extension of its lines three miles out of Stockton to Greenville.

OXNARD, CAL.—The local distribution system of the Ventura County Power Company is being put in first-class condition. New ornamental lamps will be installed on Fifth Street.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has applied to the State Railroad Commission for permission to build a transmission line from Oceanside, Cal., to San Juan Capistrano, and to put in an electrical distribution system and furnish service at the latter place.

SAN FRANCISCO, CAL.—The Board of Public Works has called for bids for furnishing reinforced concrete trolley poles for the Church Street line of the municipal electric railway system.

SANTA MONICA, CAL.—The City Council has passed an ordinance providing for the installation of ornamental cast-iron lighting posts and apparatus for the lighting of Second Street between Utah Avenue and Santa Monica Boulevard.

VALLEJO, CAL.—The Vallejo Electric Light & Power Company has been awarded a contract for street and other municipal lighting for Vallejo.

Proposals

CABLE.—Sealed bids will be received by the Commissioner of Gas and Electricity, Room 614, City Hall, Chicago, Ill., until April 25, for furnishing and delivering to the city of Chicago, fire-alarm cable in the approximate amounts, as specified, and for sundry kinds of repair parts for General Electric Company's series cut-out lamp hangers, in accordance with the specifications and drawings, on file in the office of the commissioner.

ACCUMULATORS AND MOTOR-DRIVEN PUMPS.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 23, for two motor-driven hydraulic pumps and two accumulators at the navy yard, Norfolk, Va., and one motor-driven hydraulic pump and one accumulator at the navy yard, Philadelphia, Pa. Specifications (No. 2349) can be obtained upon application to the commandants of the navy yards named or to the Bureau of Yards and Docks.

ELECTRIC PUMPING PLANT.—Bids will be received by the commissioners of the Indiana Grove Drainage District, at the office of Secretary L. A. Nickerson, Quincy, Ill., until May 1, for the construction and equipment of a drainage pumping plant, consisting of one brick building on a concrete foundation equipped with one 54-inch and one 36-inch centrifugal pump to be driven by electric motors, oil engines or steam engines; also suction bay and discharge pipes and other necessary appurtenances. Detailed plans have been prepared for an electrically-driven plant and general specifications for an oil-driven and steam-driven plant. The same may be seen at the office of the Engineer, W. P. Bushnell, Quincy, Ill.

Incorporations

HOLLAND, MICH.—Holland Lighting & Specialty Company. Capital, $35,000. Incorporators: Thomas Olinger and others.

CHICAGO, ILL.—The Electric Repair Company. Capital, $2,500. Incorporators: Edward Sherburne, J. R. Hartley and H. P. Williams.

RACINE, WIS.—Western Coil & Electrical Company. Capital, $30,000. Incorporators: J. V. Rohan, W. M. Lewis and J. W. Gilson.

BOSTON MASS.—The Frank Nason Electric Company. Capital, $50,000. Incorporators: Frank W. Nason, John W. Nason, and G. M. Nason.

BIRMINGHAM, ALA.—Oliver - Walstrum Armature Works. Capital, $12,000. Incorporators: S. W. Oliver, A. H. Walstrum and H. F. Walstrum.

PHILADELPHIA, PA.—J. F. Handshuh & Company. Capital, $10,000. Manufacture electrical devices. Charles Handshuh, principal incorporator.

PITTSBURGH, PA.—Suburban Electric Development Company. Capital, $10,000. Incorporators: A. Hattenbach, W. S. Waters and R. E. Steffan.

SPOKANE, WASH.—Swartz Electric Company of the Pacific Coast. Capital, $50,000. Incorporators: J. H. Morgan, M. L. Morgan and George Kothe.

CHARLOTTE, N. C.—Electric Supply & Equipment Company. Capital, $450,000 authorized, of which $10,000 is subscribed. Incorporators: W. H. Martin, Jr.; T. G. Lane and others.

NEW YORK, N. Y.—Brushlite Company. Capital, $10,000. Manufacture dynamos and electrical goods. Incorporators: P. S. Hill, F. M. Van Wagonen and H. A. Fluckiger, all of 27 Pine Street.

BROOKLYN, N. Y.—Huntley Electric Company. Capital, $2,500. Electrical contracting. Incorporators: J. R. Roth, Samuel Randel and M. A. Franklin, all of 74 Broadway, New York City.

WELCH, W. VA.—Welch Armature Company. Capital, $5,000. Electrical supplies. Incorporators: J. M. Lewis and J. A. Lewis, of Elkhorn, W. Va.; C. H. Ehret, T. M. Freeman and D. J. P. Strother, of Welch.

BROOKLYN, N. Y.—The Bare Wire Company. Capital, $3,000. Manufacture waterproof and insulated wire. Incorporators: E. W. Moore and G. F. Waterbury, of 10 East Forty-third Street, and John S. Keith, 40 Wall Street.

PITTSBURGH, PA.—Railway Electric Switch & Supply Company. Capital, $1,500,000. To manufacture electric railway switches. Incorporators: Wilber A. McCoy, Pittsburgh; Charles H. Jones, W. I. N. Lofland, Dover, Del.

CHICAGO, ILL.—Electric Coal Mining & Machinery Company. Incorporated in Delaware with capital of $150,000. Manufacture electric machinery. Incorporators: Seward N. Mighell, Arthur A. Bettridge and Ralph E. Battan, Chicago.

WILMINGTON, DEL.—Manchester Water Power & Manufacturing Company. Capital, $100,000. To operate electric generating plants and distributing systems. Incorporators: S. S. Adams, Jr., John G. Gray and M. B. F. Hawkins, Wilmington.

NEW YORK, N. Y.—Success Electrical Corporation. Capital, $10,000. Electrical contracting, etc. Incorporators: William Schweikert, 1238 Rogers Avenue, Brooklyn; G. A. Page, Cradell, N. J., and Murray Bierer, 59 Pearl Street, New York City.

Financial Notes

William P. Bonbright & Company, Incorporated, who are interested in a number of electric light and power companies have announced the removal of their offices from 14 Wall Street to the Equitable Building, Nassau and Cedar Streets, New York City.

The New England Telephone & Telegraph Company reports for February total operating revenue of $1,821,780, an increase of $176,344. For the first two months operating revenues increased $315,518, while operating income decreased for the same period $80,269.

Gross earnings of the Northern States Power Company for the month of February amounted to $620,162, as compared with $526,259 in the same month a year ago. Net income was $323,655, as against $299,876. For the twelve months ended February gross income amounted to $6,274,265, as

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

	Div. Rate Per cent	Bid Apr. 9	Bid Apr. 16
Public Utilities—			
Adirondack Electric Power of Glens Falls, common	....	26	25
Adirondack Electric Power of Glens Falls, preferred	6	82¼	80
American Gas & Electric of New York, common	10+extra	137	136
American Gas & Electric of New York, preferred	6	50¾	50¾
American Light & Traction of New York, common	....	358	330
American Light & Traction of New York, preferred	6	112	110
American Power & Light of New York, common	4	84	82
American Power & Light of New York, preferred	6	88½	88½
American Public Utilities of Grand Rapids, common	....	37	36
American Public Utilities of Grand Rapids, preferred	6	67	69
American Telephone & Telegraph of New York	....	123⅝	123⅛
American Water Works & Elec. of New York, common	....	12	114
American Water Works & Elec. of New York, particip	7	31	30
American Water Works & Elec. of New York, first preferred	....	81	81
Appalachian Power of Bluefield, common	....	6¼	6¼
Appalachian Power of Bluefield, preferred	7	37	35
Cities Service of New York, common	6+extra	287	292
Cities Service of New York, preferred	6	88½	87
Commonwealth Edison of Chicago	8	135	132
Comm. Power, Railway & Light of Jackson, common	4	55	56
Comm. Power, Railway & Light of Jackson, preferred	6	80	80
Federal Light & Traction of New York, common	....	12½	12½
Federal Light & Traction of New York, preferred	....	50	48
Illinois Northern Utilities of Dixon	6	80	80
Middle West Utilities of Chicago, common	2+2 extra	57	54⅞
Middle West Utilities of Chicago, preferred	6	77½	76
Northern States Power of Chicago, common	7	97	97
Northern States Power of Chicago, preferred	7	98	98
Pacific Gas & Electric of San Francisco, common	5	62¾	62¼
Pacific Gas & Electric of San Francisco, preferred	6	92	91
Public Service of Northern Illinois, Chicago, common	7	108	107
Public Service of Northern Illinois, Chicago, preferred	6	100	98½
Republic Railway & Light of Youngstown, common	4	37	36½
Republic Railway & Light of Youngstown, preferred	6	67	68
Standard Gas & Electric of Chicago, common	....	12½	12¼
Standard Gas & Electric of Chicago, preferred	6	39	38½
Tennessee Railway, Light & Power of Chattanooga, common	....	6½	7
Tennessee Railway, Light & Power of Chattanooga, preferred	6	32	32
United Light & Railways of Grand Rapids, common	4	46	42
United Light & Railways of Grand Rapids, preferred	6	74½	73
Western Power of San Francisco, common	....	15	15
Western Power of San Francisco, preferred	6	60	57
Western Union Telegraph of New York	5+ extra	96	96
Industrials—			
Electric Storage Battery of Philadelphia, common	4	62½	62
General Electric of Schenectady	8	161½	164¾
National Carbon of Cleveland, common	8	†300	†300
National Carbon of Cleveland, preferred	7	†135	†135
Westinghouse Electric & Mfg. of Pittsburgh, common	5+extra	48	48¾
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	67	70

†Last Sale.

against $5,307,438 in the previous year. Net income amounted to $3,382,894. In the year 1916 net income was $2,966,760.

The United Light & Railways Company has retired as of April 1, all the remaining outstanding bonds of the Citizens Railway & Light Company, of Muscatine, Iowa. During the calendar year, 1916, the Railways company retired or acquired about $2,230,000 bonds and preferred stock of subsidiary companies.

For the calendar year ended December 31, 1916, the net earnings of the Carolina Power & Light Company and its subsidiaries amounted to $780,027, which is equal to about 17.95 per cent on the $4,350,000 issue of common stock. This is an increase of $100,065 as compared with the net earnings for the previous year. After interest, depreciation, and sundry charges a balance of $110,077 applicable to the common stock was shown for the year.

William P. Bonbright & Company and H. M. Byllesby & Company have underwritten and will offer to the public a new issue of $1,564,000 six-per-cent gold notes of the Western States Gas & Electric Company, of California. The notes are due February 1, 1927. The proceeds will provide funds for the retirement of $621,000 notes and for extensions and additions to the properties, and payment for recently acquired water rights and storage reservoirs on the south fork of the American River.

Reports of Earnings.

AMERICAN INTERNATIONAL CORPORATION.

The annual report of the American International Corporation for the year ending December 31, 1916, the consolidated income and profit and loss account being given as follows:

Interest and dividends	$ 502,426.64
Earnings from operations	3,337,450.10
Miscellaneous expenses	908,277.73
Foreign and domestic taxes	447,655.90
Net earnings	2,483,943.11
Debit balance December 31, 1915	$ 19,023.96
Net earnings for the year 1916	2,483,943.11
Sundry adjustments	166,379.72
Dividend, December 31, 1916	375,000.00
Surplus, December 31, 1916	1,923,539.43

PACIFIC GAS & ELECTRIC.

The Pacific Gas & Electric Company has issued a corporation statement of earnings and expenses for February and for the 12 months ending February 28, as follows:

February—	1917	1916
Gross earnings	$40,008	$34,656
Operating expenses and taxes	23,351	22,767
Net earnings	16,657	11,888
Other income	27	37
Total income	16,683	11,925
Operating ratio	58.2%	65.6%
Twelve months—		
Gross earnings	$406,811	$369,290
Operating expenses and taxes	265,886	252,686
Net earnings	140,925	116,604
Other income	1,368	9,634
Total income	142,293	126,238
Bond interest	52,320	51,461
General interest	1,598	2,345
Depreciation	42,113	36,046
Net income	46,262	36,387
Preferred dividend	35,000	35,000
Surplus	11,262	1,387
Operating ratio	65.1%	68.4%

New Publications

WORKMEN'S COMPENSATION LAWS COMPILED.—The Bureau of Labor Statistics of the United States Department of Labor, Washington, D. C., has published bulletin No. 203, entitled "Workmen's Compensation Laws of the United States and Foreign Countries." This is a voluminous compilation (961 pages) of the laws on this subject of the various states and of foreign countries. It also gives a valuable comparative analysis of the legislation already enacted and discussion of the principal features of the laws. Reports of state industrial commissions are also included. Copies of this bulletin can be obtained at 75 cents each from the Superintendent of Documents, Washington, D. C.

CO-OPERATIVE SCHOOL OF ENGINEERING.—The trustees of Northeastern College of the Boston (Mass.) Young Men's Christian Association have issued a catalog of the Co-operative School of Enginering. This gives the object of the school, which is to train young men who are unable to attend technical colleges for positions in engineering work. The school work is that of an engineering school of high standards, but only the most essential subjects are taken. The plan of operation includes co-operation with manufacturing and other firms, and students alternate two weeks' of school work with similar periods of shop work, being paid for the latter. Four-year courses are now offered in electrial, mechanical, civil and chemical engineering.

Electrical Patents Issued April 10, 1917

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,221,814. **Electric-Telegraph System.** C. Adams-Randall, Boston, Mass. Special circuit arrangements.

1,221,818. **Electric-Current Brush Structure.** C. E. Becker, Chicago, Ill. Pigtail for carbon brush.

1,221,821. **Calibrating Electric Heaters.** O. T. Blathy, Budapest, Hungary. Drag magnet has its pole faces adjustable toward and away from each other.

1,221,859. **Signal-Horn.** G. Honold, assignor to firm of R. Bosch, Stuttgart, Germany. Operated by electromagnetically actuated diaphragm.

1,221,865 and 1,221,866. **Telephone-Exchange System.** L. H. Johnson, assignor to Western Electric Co., New York, N. Y. Arrangement of link circuits in conjunction with a call register.

1,221,870. **Telegraphy.** I. Kitsee, assignor to American Telephone & Telegraph Co., New York, N. Y. Employs line pulses of alternate polarity.

1,221,879. **Semi-Automatic Telephone System.** A. E. Lundell, assignor to Western Electric Co. Manner of signaling between operators and extending lines at exchange.

1,221,880. **Alternating-Current Magnet-Brake.** Q. D. Lutz, assignor to Otis Elevator Co., Jersey City, N. J. Induction motor has friction brake held off by alternating magnet.

1,221,894. **Safety Repair Device for High-Voltage Transmission Lines.** G. S. Neeley, Overland Park, Mo., assignor of one-half to T. O. Moloney, St. Louis, Mo. Structure of wire-holding clamp for mounting on line insulator. (See cut.)

1,221,906. **Spark-Plug.** M. Rall, assignor to firm of R. Bosch, Stuttgart, Germany. Has special cooling disks and non-oxidizable sparking points.

1,221,917. **Telephone-Exchange System.** A. B. Sperry, assignor to Western Electric Co. Grouping of lines in automatic system.

1,221,919. **Device for Concealing Telephone Sets.** L. A. Strasburger, New York. Hood for desk sets.

1,221,922 and 1,221,923. **Spark-Plug.** W. S. Thomas, Lock Haven, Pa., assignor of one-half to J. E. Buzzard, Lock Haven, Pa. Structural details.

1,221,924. **Indicating System for Pneumatic Conveyers.** A. F. Thompson and H. T. Free, Kansas City, Mo. Indicating lamp is lighted where package is inserted in tube and extinguished as package passes along tube.

1,221,934. **Electricity-Meter.** O. White, assignor to Sangamo Electric Co., Springfield, Ill. Mercury-bath type.

1,221,940. **Spark-Plug.** L. A. Witter, Jackson, Mich., assignor of one-half to G. A. Weber, Jackson, Mich. Has movable electrode actuated by cylinder gases.

1,221,944. **Junction or Outlet Box.** W. Wurdack, St. Louis, Mo. Details of device having separate end section snapped into engagement with main section.

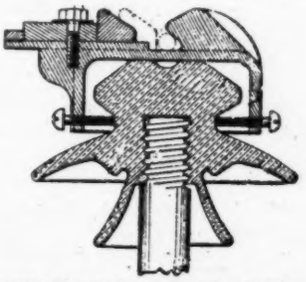
1,221,958. **Water-Cooled Welding-Electrode.** H. O. Bernard, Birmingham, Ala. Arrangement of cooling jacket.

1,221,960. **Upper Framing for Insulated Steel Railway-Cars.** H. F. Bethune and R. J. O'Neill, Denver, Colo. Structural details.

1,221,963. **Water-Indicating Means for Steam-Boilers.** W. C. Blundell, Los Angeles, Cal., assignor of one-half to M. R. Blundell, Los Angeles, Cal. Arrangement of visible and audible electric signals.

1,221,965. **Combined Head and Signal Lamp.** E. J. Boos, Cincinnati, O. A number of lamps in casing throw light at different angles.

1,221,968. **Automatic Train-Stop System.** J. Cannon, Nashville, Tenn., assignor of one-half to B. Levitan, Nashville, Tenn. Air-brake vent is controlled through trolley.



No. 1,221,894.—Safety Repair Device for High-Voltage Transmission Lines.

1,221,981. **Alternating-Current Rectifier.** T. A. Edison, assignor to New Jersey Patent Co., West Orange, N. J. Contacts are actuated by a number of vibratory armatures operated by electromagnet. (See cut, next page.)

1,221,991. **Method of Making Battery-Depolarizers.** M. E. Holmes, assignor to National Carbon Co., Cleveland, O. Pulverized carbon is agitated in potassium permanganate solution and manganese peroxid is precipitated in intimate contact with the carbon particles.

1,221,998. **Electrical Condenser for Ignition-Current Generators.** F. Kratz, assignor to firm of R. Bosch, Stuttgart, Germany. Structural details.

1,222,001. **Electrical Heating Unit.** R. Kuhn and A. Oakes, assignors to F. Kuhn, Detroit, Mich. Strip of insulation has notched edges, the resistor is wound through the notches and across one face of the strip, the other face having a reinforcement.

1,222,022. **Connector for Electrical Terminals.** C. F. Paul, Jr., Peekskill, N. Y., assignor of one-half to C. G. Ballin, New York, N. Y. Special terminals are clamped between sections of insulation.

1,222,040. **Horn.** M. Setter, Chicago, Ill. Mechanical horn is electromechanically controlled.

1,222,042. **Electric Meter.** K. R. Singer, assignor to Siemens Schuckert Werke, Gesellschaft mit beschrankter Haftung, Germany. Of the Ferraris type.

1,222,043. **Telephone System.** F. M. Slough, assignor to Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y. Details of cord circuits.

1,222,052. **Magnetic Chuck.** O. S. Walker, assignor to O. S. Walker Co., Worcester, Mass. Structural details of work face, pole pieces, etc.

1,222,077. **Fraud-Detecting Telephone Toll System.** V. D. Cousins, assignor to American Telephone & Telegraph Co., Boston, Mass. Fraud is indicated by signal at central.

1,222,078. **Signaling Device for Automobiles.** E. G. Cox, Newport News, Va. Position of electromagnetically operated signal is indicated by lamp.

1,222,083. **Display Apparatus.** F. G. Dickerson, Chicago, Ill. Manner of controlling a number of sets of differing sign elements.

1,222,090. **Electrically Operated Trolley Door.** T. W. Findley, Minneapolis, Minn. Arrangement of motors and control for lifting doors and turning it from vertical to horizontal position or vice versa.

1,222,091. **Display Apparatus.** W. A. Fricke, Oakland Park, Ill., assignor of one-half to F. G. Dickerson, Chicago, Ill. Relates to same subject matter as No. 1,222,083.

1,222,092. **Display Apparatus.** W. A. Fricke, Chicago, Ill., assignor of one-half to F. G. Dickerson, Chicago, Ill. Relates to above.

1,222,093. **Display Apparatus.** W. A. Fricke, Chicago, Ill. Relates to above.

1,222,107. **Horn.** A. A. Kent, Philadelphia, Pa. Structure of rotary motor-operated device.

1,222,119. **Filament for Incandescent Bulbs.** A. S. Moffat, assignor to Kunz-Wheeler-Moffat Co., Belmont, Mass. Arrangement of number of straight helices.

1,222,132. **Clamping Device for Trolley and Other Purposes.** S. A. Redding, Atlanta, Ga. Structure of suspension clamp.

1,222,136. **Electrically Operated Door.** J. C. Reynolds, Binghamton, N. Y. Special control of electric operating motor.

1,222,151. **Pay-Telephone Electric Recorder.** A. F. Sipperley, Denver, Colo. Coin-controlled, electromagnetically operated.

1,222,159. Electric Bell. M. Suwa, Tokyo, Japan. Structural details of electromagnetic vibratory device.

1,222,165. Metallic Receptacle and Method of Welding the Same. F. G. Wacker, assignor to C. H. Wacker, Chicago, Ill. Manner of electrically welding barrel chime structure.

1,222,181. Electrically Heated Fireless Cooker. C. B. Carman, Salineville, O. Structure of casing and mounting of heat unit.

1,222,182. Compression Rheostat. E. L. Clark, assignor to National Carbon Co. Pile of carbon blocks, each with an iron radiating plate to which it is secured.

1,222,183. Alarm Device for Liquid-Levels. A. Cohen, Chelsea, Mass. Structure of float-controlled contacts.

1,222,187. Controller. W. R. Davis, assignor to Cutler-Hammer Mfg. Co., Milwaukee, Wis. For motor-operated valves.

1,222,189. Float-Controlled Electric Indicator. S. Deutsch, Detroit, Mich. For application to the intake of a gasoline tank.

1,222,196. Electrical Heating Resistance. F. M. Furber, assignor to United Shoe Machinery Co., Paterson, N. J. Details of inclosed tubular unit.

1,222,197. Electric Unit. F. M. Furber, assignor to United Shoe Machinery Co. Has a lava core with interior steel supporting member.

1,222,198. Torpedo-Firing Control and and Signal Apparatus for Torpedo-Boats. E. G. Gallagher, assignor to Lake Torpedo Boat Co., Bridgeport, Conn. Admission of firing air is controlled electromagnetically and signal lamp is controlled by outbound tube cover.

1,222,207. Motor Controller. C. T. Henderson, assignor to Cutler-Hammer Mfg. Co. Combination of foot and hand control for motor vehicles.

1,222,214. Electric Switch. C. J. Klein, assignor to Cutler-Hammer Mfg. Co. Structure of push-button, snap device.

1,222,215. Circuit-Controller. C. J. Klein, Milwaukee, Wis. Push-button wall switch for connecting circuits in series or parallel.

1,222,222. Automobile Starter. P. M. Lincoln, Pittsburgh, Pa. Relates to gearing between motor and engine.

1,222,225. Lamp Socket. A. C. McWilliams, Chicago, Ill. For series lighting circuits.

1,222,239. Electrolysis of Alkaline Haloids. K. Ochs, assignor to Siemens & Halske, A. G., Berlin, Germany. Manner of manipulating the gases and solutions.

1,222,243. Manufacture of Glassware. K. E. Peiler, assignor to Hartford-Fairmont Co., Canajoharie, N. J. Molten glass is severed by forming a reduced neck and passing current through it.

1,222,257. Storage-Battery Charger. C. Auth, assignor to E. L. Auth, Brooklyn, N. Y. Circuit connections for charging from a high-tension system.

1,222,303. Quadruplex Telegraphy. I. Kitsee, assignor to American Telephone & Telegraph Co. Method of quadruplexing a line with capacity.

1,222,305. Electrostatic Separator for Inflammable Materials. J. Kraus, Brunswick, Germany. Material is attracted by electrode which is poor electrical conductor and a dielectric conveyer between the material path and electrode prevents material from reaching the electrode and carries it out of the electrostatic field.

1,222,311. Message-Register Circuits. A. E. Lundell, assignor to Western Electric Co. Manner of connecting in an electromagnetically operated service-meter.

1,222,312. Vehicle Lamp. C. McKeever, Jersey City, N. J., assignor of one-third to W. H. Dickinson and one-third to C. B. Mears, New York, N. Y. Has two lamp bulbs facing each other in the axial center of the lamp.

1,222,323. Telephone-Exchange System. A. Raynsford, assignor to Western Electric Co. Arrangement of cord circuits, etc., in manual system.

1,222,333. Fire-Alarm System. C. Z. Smith, South Bethlehem, N. Y. Arrangement of heat-actuated circuit-closers, circuit-breakers and alarms at each of several stations, all of the alarms being operated on operation of one of the circuit-closers with provision for testing from a central.

1,222,342. Telephone-Exchange System. R. S. Wilbur, assignor to Western Electric Co. Manual.

1,222,343. Extension Telephone-Signal. P. J. Wires, Indianapolis, Ind., assignor of one-half to A. B. Gooley, Indianapolis, Ind. Steam whistle is controlled by circuit energized from high-potential lighting system.

1,222,348. Electric Telephone Talking Machine. E. H. Amet, Redondo Beach, Cal. Needle operates transmitter electrically connected with receiver on tone arm.

1,222,350. Protector. H. G. Bandfield, assignor to Western Electric Co. Structure of grounding gap for telephone lines.

1,222,355. Switch. S. Buchsbaum, Chicago, Ill. Two-push-button, snap device.

1,222,364. Connecting-Circuit for Telephone Switching Systems. H. P. Clausen, assignor to Western Electric Co. Arrangement of link circuit in manual system.

1,222,365. Protector. W. L. Cook, Chicago, Ill. Structure of fuse carrier for insertion in line wire.

1,222,402. Method and Apparatus for Fractionating Hydrocarbons. L. E. Hirt, Charleston, W. Va. Comprises subjecting oil in a spray to an electric arc.

1,222,412. Voltage Regulator. C. H. Kicklighter, assignor to Westinghouse Electric & Mfg. Co. Relates to control of generator-field excitation.

1,222,425. Electrical Vaporizer. J. H. Lepper, Mason City, Iowa. Plug-like structure comprising heating resistor, adapted for attachment to engine manifold.

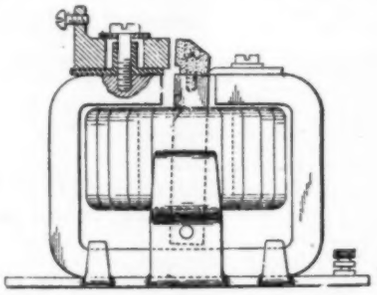
1,222,426. Heating Means for Carbureters. J. H. Lepper. Structure similar to above applied to a carbureter.

1,222,427. Headlight. J. W. Lewellen, Kidal, and F. P. Homer, Aldan, Pa. Arrangement of main and auxiliary, adjustable translucent screens.

1,222,431. Electromagnetic Apparatus. D. J. McCarthy, assignor to Union Switch & Signal Co., Swissvale, Pa. Special structure comprising combination of two motor devices giving desired distribution of torque through range of operation.

1,222,439. Electric Switch. E. B. Merriam, assignor to General Electric Co. Special structure of oil switch wherein oil is forced against arc by pressure created by arc.

1,222,440. Frequency-Changing System. F. W. Meyer, assignor to Westinghouse



No. 1,221,981.—Alternating-Current Rectifier.

Electric & Mfg. Co. Reversible system comprising two mercury-vapor devices.

1,222,442. Tail-Light. A. W. Morford, New Monmouth, N. J. Arrangement of casing, reflector and lights.

1,222,461. Lightning-Arrester for Telephones. L. H. Pierson and H. C. Willitz, Janesville, Wis. Carbon block grounding gap in combination with switch.

1,222,464 and 1,222,465. Dynamoelectric Machine. E. D. Priest, assignor to General Electric Co. Structural details of railway motors with special reference to ventilation.

1,222,469. Variable-Speed Electric Motor. E. R. Altrincham, assignor to Westinghouse Electric & Mfg. Co. Special combination of exciter with compound, direct-current motor.

1,222,479. Control System. K. A. Simmon, assignor to Westinghouse Electric & Mfg. Co. Electropneumatically operated pantograph trolley.

1,222,492. Fluid-Meter. C. C. Thomas, Madison, Wis. Fluid flow is ascertained by noting the heating effect thereon of an electric resistor.

1,222,493. Face-Plate for Flush Receptacles. G. B. Thomas, assignor to Bryant Electric Co., Bridgeport, Conn. Structural details.

1,222,512. Driving Connection for Motor-Driven Fans. C. Aalborg, assignor to Westinghouse Electric & Mfg. Co. For producing oscillation of the fan.

1,222,518. Electric Signal for Railways. C. L. Bopp, Waterloo, Iowa. Details of circuits, etc., for air-brake and signal control.

1,222,529. Train-Stop. H. B. Colstan, Great Bend, Pa. Operates by controlling connection of current source with third rail.

1,222,536. Protective Device for Systems of Distribution. A. H. Davis, assignor to General Electric Co. System of interconnection of circuit-breakers in a number of circuits.

1,222,537. Keep-Alive Anode. D. C. Davis, assignor to Westinghouse Electric & Mfg. Co. For vapor electric apparatus.

1,222,539. Electric Motor System. C. De Kando, assignor to Westinghouse Machine Co. Relates to grouping of induction motors in a vehicle drive.

1,222,547. Synchronizing Device. W. B. Jackson, Chicago, Ill., assignor of one-half to D. C. Jackson, Chicago, Ill. For automatically holding controlling and controlled motors in synchronism.

1,222,567. Transmitting Apparatus for Wireless Telegraph Stations. F. G. Simpson, Seattle, Wash. Arrangement of trigger, oscillating and charging circuits, comprising a mercury valve.

1,222,573. Portable Incandescent Lamp. M. Claussen and W. A. McKay, San Francisco, Cal. Structure of adjustable support.

1,222,583. Railway Signaling. H. S. Young, assignor to Union Switch & Signal Co., Swissvale, Pa. Block-signal system.

1,222,585. Circuit-Coupling for Electrically Heated Utensils. F. E. Carlson, assignor to Landers, Frary & Clark, New Britain, Conn. Structure of plug connector for engaging exposed circuit terminals.

PATENTS EXPIRED.

The following United States electrical patents expired on April 17, 1917:

647,456. Automatic Maximal Switch for Electric Power and Lighting Currents. Theodor Allemann, Olten, Switzerland.

647,471. Cable Joint. W. M. Brown and G. M. McFeaters, Johnstown, Pa.

647,475. Battery-Handling Attachment for Motor Vehicles. George H. Condict, New York, N. Y.

647,492. Electromagnetic Switch Arrangement. P. Hoffmann, Charlottenburg, Germany.

647,536. Zinc Support for Batteries. S. E. Smith, Beloit, Wis.

647,565. Electric Thermostat for Fire Alarms. H. V. Hayes, Cambridge, and G. K. Thompson, Malden, Mass.

647,570. Railway-Signaling Apparatus. E. A. Landee, Moline, Ill.

647,584. Inductor Alternator. S. H. Short, Cleveland, O.

647,585. Means for Balancing Multipolar Electric Machines. S. H. Short, Cleveland, O.

647,588. Combined Telephone and Electrothermostatic Fire-Alarm System. G. K. Thompson, Malden, Mass.

647,589. Induction Coil. R. Varley, Jersey City, N. J.

647,614. Electric Furnace. M. Ruthenburg, Philadelphia, Pa.

647,617. Electric Gas-Lighting Device. G. Schunemann and O. Rieder, Budapest, Austria-Hungary.

647,624. Trolley Fork. E. Eddy, New York, N. Y.

647,634. Electric Lighting Apparatus for Railway Cars. W. F. Richards, Buffalo, N. Y.

647,637. Switch-Operating Mechanism for Railways. C. W. Squires and J. B. Squires, Springfield, Mass.

647,666. Electric-Railway System. J. M. Murphy, Torrington, Conn.

647,671. Door Controller. M. A. De Lew, Sacramento, Cal.

647,687. Electro-Therapeutic Device. T. W. Topham, New York, N. Y.

647,691. Electric Arc Lamp. J. T. Beswick, New York, N. Y.

647,694. Electric Metal-Working Apparatus. G. D. Burton, Boston, Mass.

647,716. Method of Regulating Electric Machines. W. H. Cooley, Brockport, N. Y.

647,723. Automatic Damper Regulator. J. T. Luton, Evansville, Ind.

647,729. Apparatus for Recording Morse Telegraphic Characters. C. Stevens, C. C. Vyle and W. Milner, London, England.

647,737. Tablet Attachment for Telephones. G. S. Williamson, New York, N. Y.

647,741. System of Electrical Transmission. F. Bedell, Ithaca, N. Y.

647,743. Electric-Motor Controller. H. Cochrane, Chicago, Ill.

647,748. Plow for Conduit Electric Cars. J. B. Gottsberger, New York, N. Y.

647,752. Storage-Battery Electrode. R. Macrae, Baltimore, Md.

647,783. Switch Apparatus for Electric Current-Distributing Circuits. T. Allemann, Olten, Switzerland.

647,797. Galvanic Battery. H. Blumenberg, Jr., and F. C. Overbury, New York, N. Y.

647,829. Electric Switch. J. I. Gunther, New York, N. Y.

647,858. Process of Obtaining Permanent Deposits of Metals on Aluminum. E. Mies, Budesheim, Germany.

647,874. Electric Arc Lamp. C. A. Pfluger, Chicago, Ill.

647,914. Battery Receptacle for Electric Vehicles. G. H. Condict, Hartford, Conn.

647,924. Pulley for Overhead Telephone Cables. W. H. Kennedy, Akron, O.